TP5115E

Impact Assessment of ALRT

Study Design

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Transport Canada

BC Transit

TP5115E

Impact Assessment of ALRT

Study Design

by:
Paul O. Roer, P. Eng.
et al.
MacLAREN PLANSEARCH

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17. **Abstract**

This report describes a study design for the investigation of the impacts of constructing and operating the ALRT (advanced light rapid transit) system in Vancouver, B.C. Seven broad impact categories (with a number of associated subcategories) are identified:

1. Planning and construction (land acquisition, etc.).
2. Transportation and travel (mode choice, travel patterns, etc.).
3. Direct local effects (local opinion, visual effects, etc.).
4. Indirect local effects (energy supply).
5. Urban development (land economics, etc.).
6. Economic impacts (tourism and recreation, etc.).
7. Social impacts (demographics).

The study design outlines research questions, methodology, data sources and research tasks for each impact subcategory.

A similar design is presented for a technology assessment of the ALRT system. The study design calls for two areas of research: (1) system documentation: a detailed description of the system, its technologies and design characteristics; and (2) performance evaluation: a comparison of such factors as safety, reliability and energy consumption of the ALRT and other comparable systems.

Also presented is an implementation process for the impact study and technology assessment. The process addresses alternative study scopes, deliverables, management and scheduling.

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17. Résumé
Ce rapport décrit la démarche proposée pour la recherche des impacts que peuvent avoir la réalisation et l'exploitation du TLRA (transport léger sur rail, de type avancé) à Vancouver, Colombie-Britanique. Il identifie les sept grans éléments à prendre en compte (chacun comportant un certain nombre d'éléments secondaires):

1. Planification et réalisation (emprise, etc.)
2. Liaison et déplacements (choix modaux, comportements, etc.)
3. Impacts directs (opinion des riverains, impact visuel, etc.)
4. Impacts indirects (alimentation en énergie).
5. Aménagement du territoire (utilisation des sols, etc.)
6. Impacts économiques (effets sur le tourisme et les loisirs, etc.)
7. Impacts sociologiques (impact démographique).

La démarche proposée suggère les questions à élucider, la méthodologie à adopter, les sources d'information et les tâches à entreprendre, pour chacun des éléments secondaires mentionnés.

Le rapport propose, en outre, une démarche analogue concernant l'évaluation technologique du système TLRA envisagé. Pour cela, il suggère deux champs de recherche: (1) définition documentaire, c'est-à-dire étude descriptive du système, des technologies en présence et des caractéristiques recherchées; (2) évaluation technique débouchant sur un bilan comparatif du système TLRA par rapport à d'autres systèmes comparables, sur les plans de la sécurité, la fiabilité, la consommation, etc.

Le rapport propose, enfin, une procédure pour l'étude d'impact et l'évaluation technologique envisagées, faisant état de certains impératifs tels que la portée plus ou moins vaste de l'étude, les produits finals, la gestion et l'ordonnancement.

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TABLE OF CONTENTS

FOREWORD

1.0 INTRODUCTION 1

2.0 IMPACT ASSESSMENT 5

2.1 Planning and Construction 13
2.2 Direct Local Effects 17
2.3 Transportation and Travel 21
2.4 Indirect Local Effects 25
2.5 Urban Development 29
2.6 Economics 35
2.7 Social Impacts 43

3.0 TECHNOLOGY ASSESSMENT 47

3.1 System Documentation 47
3.2 System Performance Evaluation 47

4.0 IMPLEMENTATION PROCESS 51

4.1 Alternative Study Scopes 51
4.2 Deliverables 53
4.3 Study Management 58

Appendix A ALRT Specifications, Service Standards and Projected Ridership

Appendix B Baseline Conditions, Impact Measurement and Conceptual Framework

Appendix C Guidelines for Preparing Research Task Designs

Appendix D A Sample Research Task Design: Visual Baseline Survey

Appendix E A Sample Research Report: Visual Baseline Survey

LIST OF FIGURES

Figure 1 ALRT Regional Context x
Figure 2 Development of Study Design 3
Figure 3 Study Design Process 4
Figures 4.1-4.7 Impact Categories 6-12
Figure 5 Study Work Schedule 55
Figure 6 Study Participants 60

LIST OF TABLES

Table 1 Alternative Scopes 52
Table 2 Deliverables 54
Table 3 Study Management Options 59

FOREWORD

Advanced Light Rapid Transit (ALRT) is a Canadian innovation in urban transportation technology. It is being installed in metropolitan Vancouver by B.C. Transit (B.C.T.) to increase the capacity of the existing all-bus public transit system, and to serve as a major link in the regional system. Construction of the first phase, between downtown Vancouver and downtown New Westminster, began in the spring of 1982. Its completion in early 1986 will correspond with the opening of Expo 86 in Vancouver.

Phase I serves a 21.5 km corridor with 15 stations. The double tracked guideway is elevated over two-thirds of its distance and runs underground in downtown Vancouver. As shown in Figure 1, future extensions have been planned for Surrey and other suburban centres.

The Urban Transportation Development Corporation developed the design and is now manufacturing the vehicles under contract to B.C. Transit. This intermediate capacity system is fully automated and features linear induction motor propulsion. The computer controlled vehicles are designed to operate in pairs with up to six cars travelling together during rush hours. Detailed design specifications and estimated passenger demand are given in Appendix A.

The implementation of ALRT has presented the opportunity to document and assess the impacts of a new technology and a new transit experience in a major Canadian city. B.C. Transit, in cooperation with the Transportation Development Centre of Transport Canada, initiated the idea of an impact study and provided funding for the preparation of a study design.

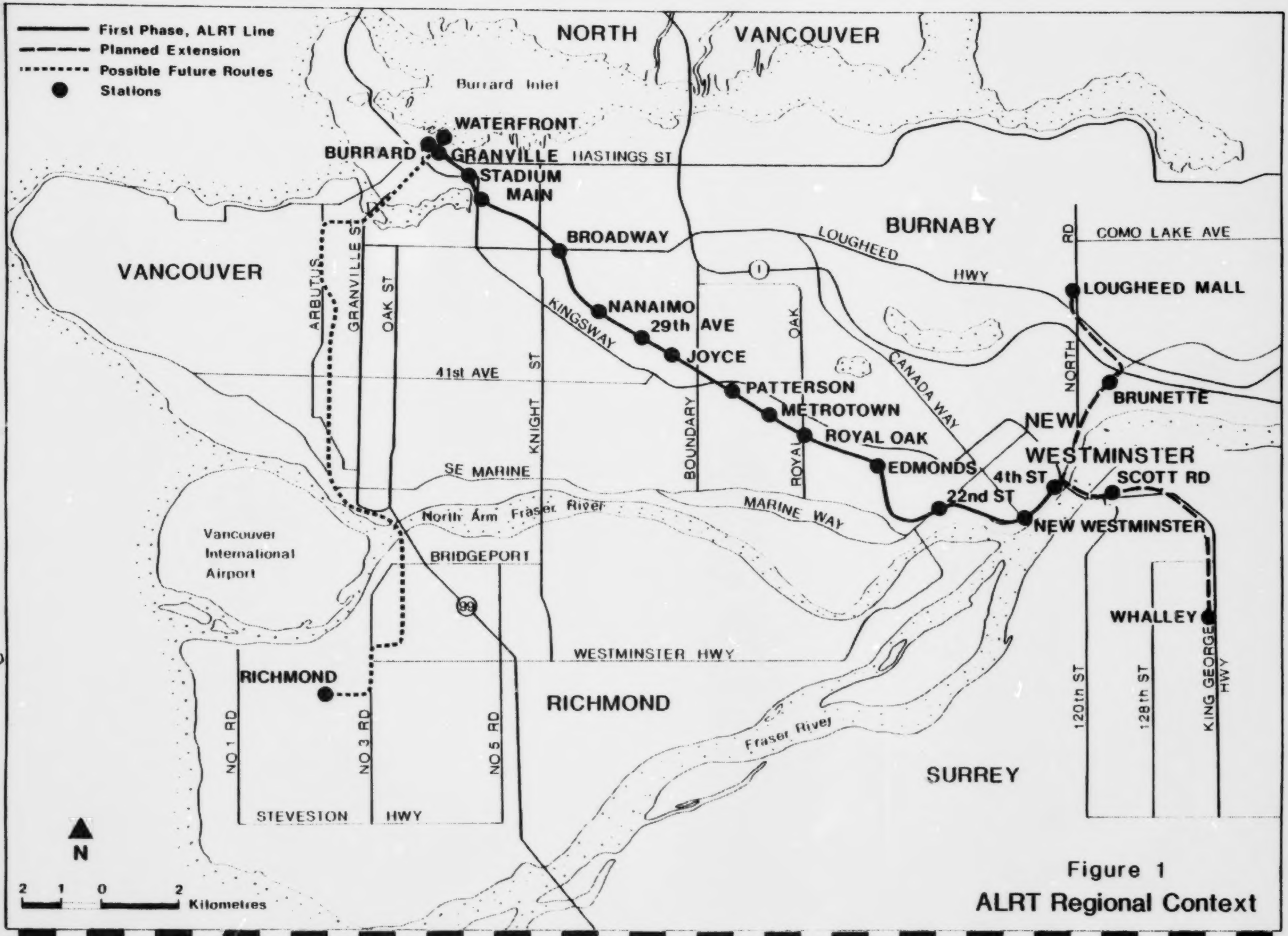
As stated in the study design terms of reference, the impact study shall be a comprehensive and systematic evaluation of the ALRT system in the Vancouver metropolitan area. The specific goals are to:

1. Define and measure all significant changes in the social, economic and environmental infrastructure of metropolitan Vancouver that can be reasonably attributed to ALRT construction and/or operation, either directly or as a spin-off, and within the local and global context;

2. Evaluate impacts according to measurable change using physical measurements and/or the criterion measure of a community standard; and

3. Document and evaluate the technology for national and international dissemination.

The study design, as the first stage of the project, provides the tool for implementing research. Although the initial focus of the study centres on the Vancouver to New Westminster corridor, the design is applicable to future corridor extensions.



First Phase, ALRT Line
Planned Extension
Possible Future Routes
Stations
NORTH
VANCOUVER
Burrard Inlet
WATERFRONT
BURRARD
GRANVILLE
HASTINGS ST
STADIUM
MAIN
BURNABY
BROADWAY
LOUGHEED
HWY
COMO LAKE AVE
RD
LOUGHEED MALL
VANCOUVER
1
ARBUTUS
GRANVILLE ST
OAK ST
NANAIMO
29th AVE
KINGSWAY
JOYCE
OAK
41st AVE
PATTERSON
CANADA WAY
NORTH
BRUNETTE
METROTOWN
KNIGHT ST
BOUNDARY
ROYAL OAK
NEW
WESTMINSTER
ROYAL
EDMONDS
SE MARINE
4th ST
SCOTT RD
22nd ST
North Arm Fraser River
MARINE WAY
NEW WESTMINSTER
Vancouver International Airport
BRIDGEPORT
99
WHALLEY
WESTMINSTER HWY
RICHMOND
RICHMOND
NO 1 RD
NO 3 RD
NO 5 RD
Fraser River
120th ST
128th ST
KING GEORGE HWY
SURREY
STEVESTON HWY
N
2 1 0 2 Kilometres

Figure 1
ALRT Regional Context

1.0 INTRODUCTION

Vancouver, like most cities, has experienced changes in transportation systems in response to increased urbanization and population growth. In the 1890's electric streetcars provided regular transit service in Vancouver and an inter-urban railway system connected the City to various suburban centres. These systems were replaced by trolley and diesel buses in the 1950's. The Sea Bus ferry operation that began in 1977 between downtown Vancouver and North Vancouver, provided a marine transit link in the existing regional all-bus system.

Significant population increases in the sixties shifted urban growth towards the suburbs of Vancouver. This trend placed an extra demand on passenger capacity in the region. Several transportation alternatives were proposed to increase capacity and reduce traffic congestion between Vancouver and the suburbs. They included freeway extensions, rapid transit, additional 'bus lanes only', etc. With public opposition to freeway development rapid transit was considered a viable alternative. It was not until the 1970's, however, that this alternative was actively pursued.

The Liveable Regional Plan (1972) incorporated light rapid transit as part of an overall scheme of decentralization to regional towncentres structured on transportation systems. Selection of the rapid transit corridors was based on the availability of existing rights-of-way and demand for services. The decision to use the ALRT technology was made in 1980.

ALRT signifies the first major commitment to a new transportation system in the region. In the past, roads, bridges, major highways, overpasses, etc., were added incrementally to the existing road network. At a cost of more than three quarters of a billion, compared to road system improvements worth about $250 million over the past 30 years, ALRT represents the largest single transportation capital investment made in the region. This financial commitment and the use of a sophisticated and newly developed technology are an important concern to the people of B.C.

The provision of ALRT service in metropolitan Vancouver has sparked many issues of concern to people living in the region, and specifically to people living near the chosen line. At the regional level, particular attention has focussed on the location of the facility as a direct benefit to some groups while others would welcome similar service improvements. ALRT is expected to provide greater connectivity between regional towncentres for recreational pursuits, seeking employment or finding a place to live. Additional changes in transit services that will require re-orientation of travel patterns have also been anticipated.

People who live near the line are concerned primarily with physical changes that may affect their home and neighbourhood environment. Construction inconveniences, although temporary, relate to increased noise and traffic. With ALRT in operation, major issues will focus on noise, view loss, privacy, and safety. Specific problems are anticipated with increased on-street parking and traffic, redevelopment pressures, neighbourhood fragmentation and open-space treatment.

The ALRT study has been designed to focus on what happens to an urban system when a new rapid transit facility is introduced. ALRT is expected to act as a catalyst for different types of change with varying levels of intensity within metropolitan Vancouver. The study design serves as a guide for investigating these urban system changes. The design coordinates research, analysis and reporting.

Few transportation impact studies have been started prior to project implementation. A common approach has been to address impacts well after the completion of a transportation facility or to forecast anticipated impacts before construction begins. A study that extends from the construction phase to well into operations enables a systematic approach to data collection, research and analysis at appropriate points in time. Earlier studies have revealed that many long-term effects do not manifest themselves until after 10 or more years. It is also evident that impact issues change constantly as a long-term study progresses. This suggests that a flexible research program is an important requirement.

These and other ideas from various impact studies have provided background information for the study design. The initial steps taken to develop the design are outlined in Figure 2. They are discussed in detail in Appendix B and are specified below:

- devise a conceptually sound, yet practical, definition of baseline for impact measurement;
- devise a conceptual framework within which both positive/negative, long/short-term and construction/operational effects can be measured and evaluated in a systematic and structured way;
- identify relevant impacts and, where possible, devise quantifiable measures of impact;
- devise an evaluative framework for impacts and system performance; and
- draft relevant research questions.

The study design process includes the formulation and specification of initial research questions, methodologies and data requirements (refer to Figure 3). The questions reflect major impact issues and concerns that require investigation and explanation. The significance of the issues is measureable through the use of clearly defined methods and an efficient data base. The establishment of baseline conditions for impact measurement forms an integral part of this process. Comparison of ALRT with No-ALRT by using control areas and in some cases, the service corridor itself, provides an important

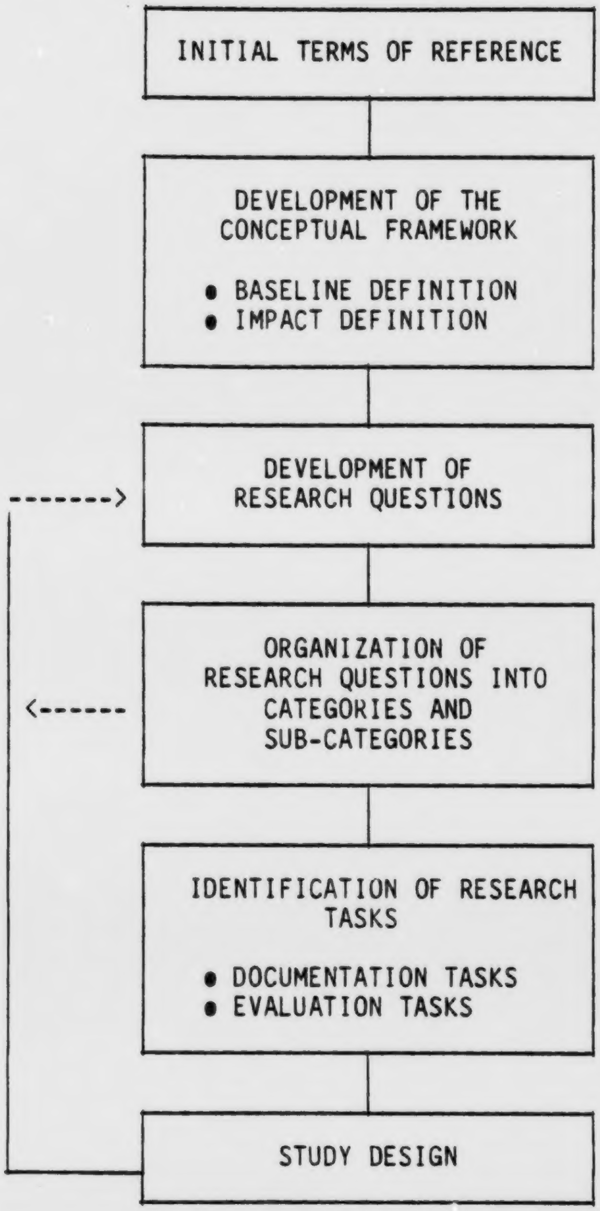

INITIAL TERMS OF REFERENCE
DEVELOPMENT OF THE CONCEPTUAL FRAMEWORK
• BASELINE DEFINITION
• IMPACT DEFINITION
DEVELOPMENT OF RESEARCH QUESTIONS
ORGANIZATION OF RESEARCH QUESTIONS INTO CATEGORIES AND SUB-CATEGORIES
IDENTIFICATION OF RESEARCH TASKS
• DOCUMENTATION TASKS
• EVALUATION TASKS
STUDY DESIGN

Figure 2
Development of Study Design

means for measuring the intensity of change or impact. The rationale underlying this base condition and alternative concepts is given in Appendix B.

Study designs for 'impact assessment' and 'technology assessment' are given in the following parts. The former addresses the effects of building and operating ALRT while the latter deals with performance and design characteristics. They will be produced as separate documents for the final report. An additional component of the final report is the inclusion of a historical perspective on transportation in Vancouver.

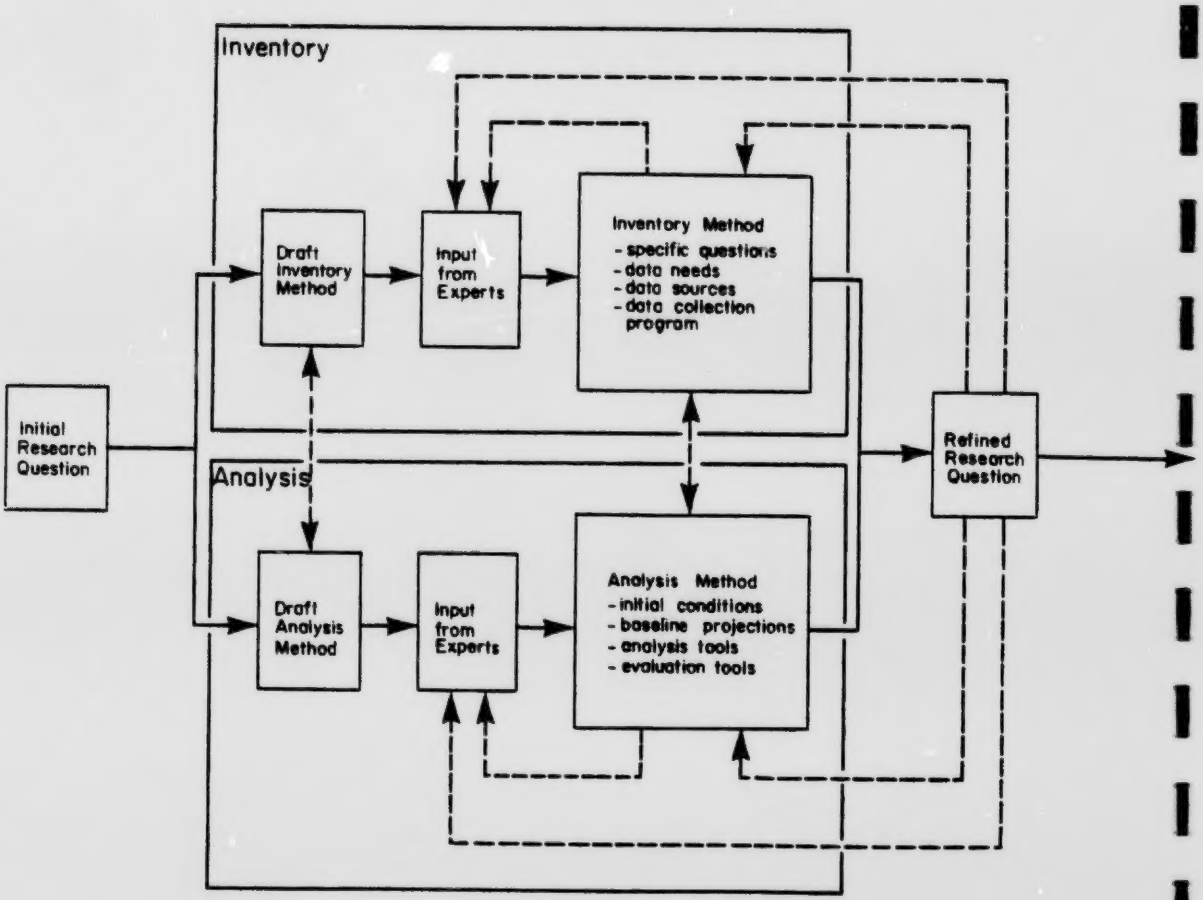

Inventory
Initial Research Question
Draft Inventory Method
Input from Experts
Inventory Method
- specific questions
- data needs
- data sources
- data collection program
Analysis
Draft Analysis Method
Input from Experts
Analysis Method
- initial conditions
- baseline projections
- analysis tools
- evaluation tools
Refined Research Question

Figure 3
Study Design Process

2.0 IMPACT ASSESSMENT

The study design uses categories to classify major areas of impacts. Although many categories are closely related, each functions as a tool for dealing with a particular aspect of the urban system. Figures 4.1 to 4.7 show the division of impact categories into more detailed sub-categories and related research tasks or contractable projects. The implementation of the research tasks involves the development of detailed study designs before any research is carried out. The task designs and research projects will be initiated at various stages throughout the study period.

The contents of the study design are provided in the following sections according to impact categories. Research questions, methods and data requirements are given at the sub-category level. This design process is repeated with greater refinement and detail in the preparation of a research task design, as illustrated in Appendix D. Guidelines for preparing task designs are given in Appendix C. An example of the completed research task, 'Visual Baseline Survey', (Appendix E), demonstrates the effectiveness of the study design process for implementing research.

The research tasks provide the technical background for each category report. The initial research questions addressed in this study design will be answered as part of the synthesis and evaluation of each category. The final report draws upon the category reports to present a global picture of ALRT effects in the region. The final results will serve a variety of purposes including:

- the identification of the significant impacts of ALRT on the Vancouver urban system, who was affected by the impacts and the distributional effects; and
- the identification of ALRT's contribution as a transportation solution in the region.

In addition, the final product may identify problem areas associated with ALRT. This will serve as a useful guide to overcome difficulties in future applications of the system.

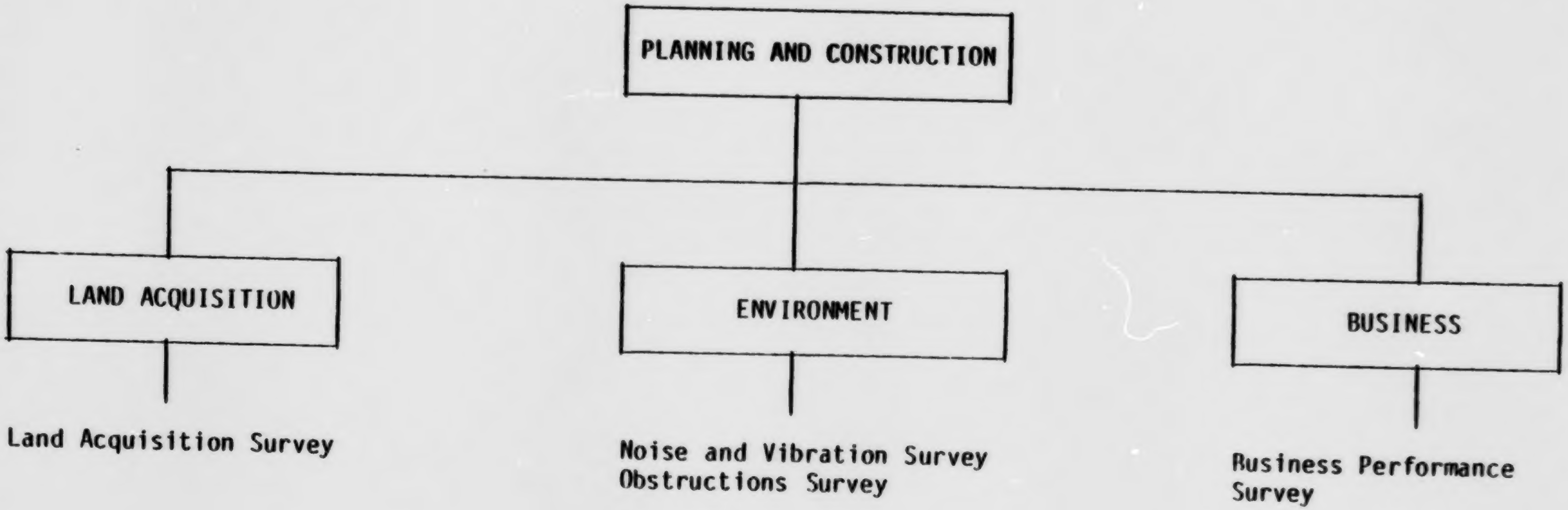

PLANNING AND CONSTRUCTION
LAND ACQUISITION
ENVIRONMENT
BUSINESS
Land Acquisition Survey
Noise and Vibration Survey
Obstructions Survey
Business Performance Survey

Figure 4.1

Category One

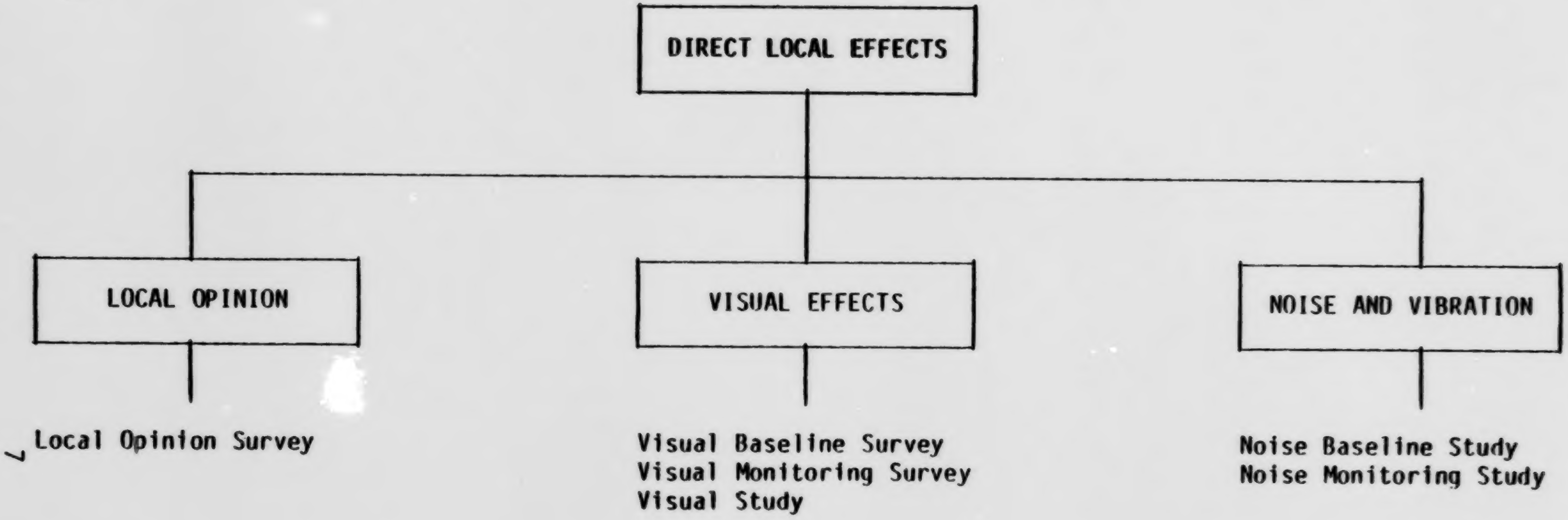

DIRECT LOCAL EFFECTS
LOCAL OPINION
VISUAL EFFECTS
NOISE AND VIBRATION
Local Opinion Survey
Visual Baseline Survey
Visual Monitoring Survey
Visual Study
Noise Baseline Study
Noise Monitoring Study

Figure 4.2
Category Two

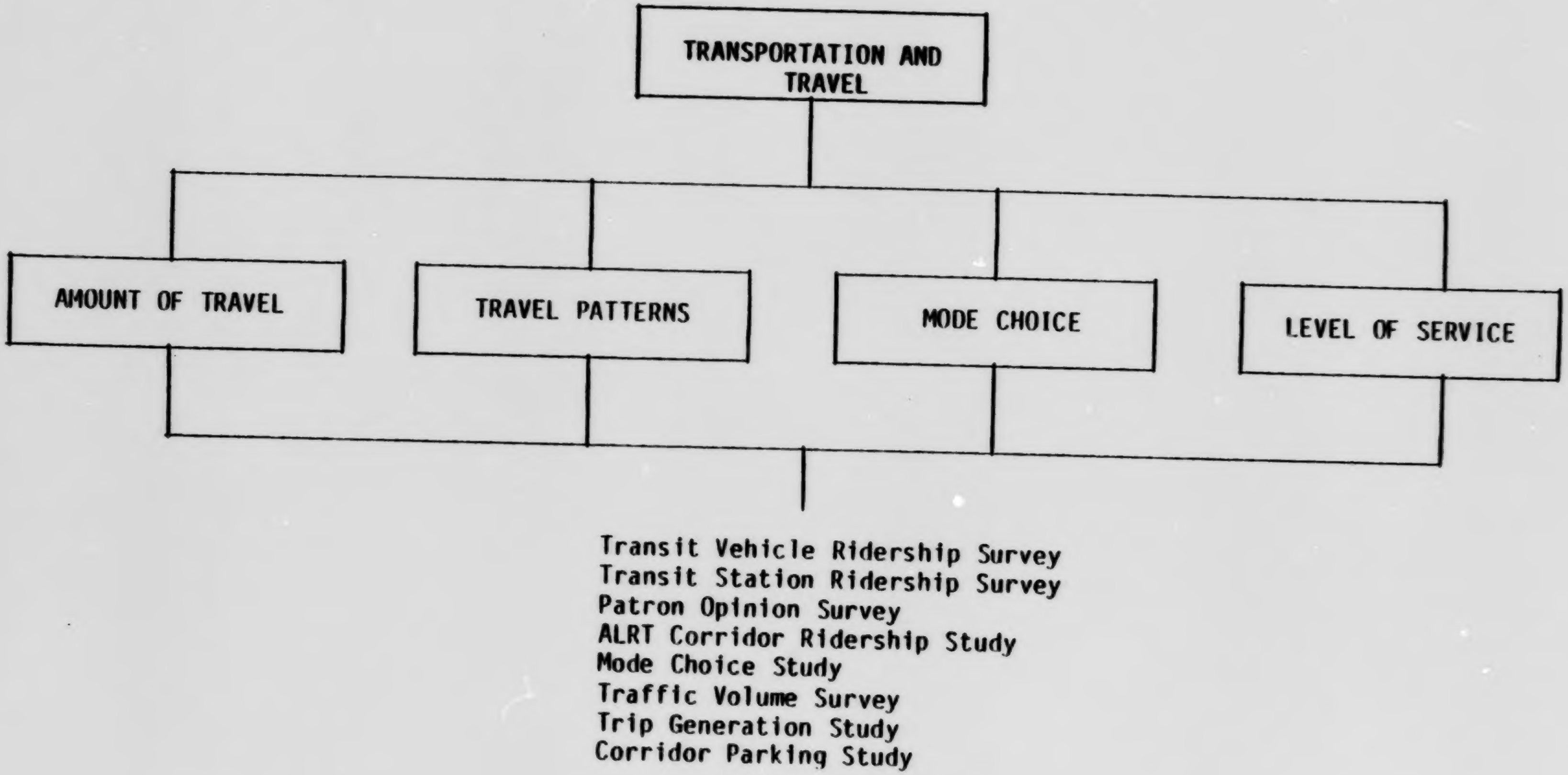

TRANSPORTATION AND TRAVEL
AMOUNT OF TRAVEL
TRAVEL PATTERNS
MODE CHOICE
LEVEL OF SERVICE
Transit Vehicle Ridership Survey
Transit Station Ridership Survey
Patron Opinion Survey
ALRT Corridor Ridership Study
Mode Choice Study
Traffic Volume Survey
Trip Generation Study
Corridor Parking Study

Figure 4.3
Category Three

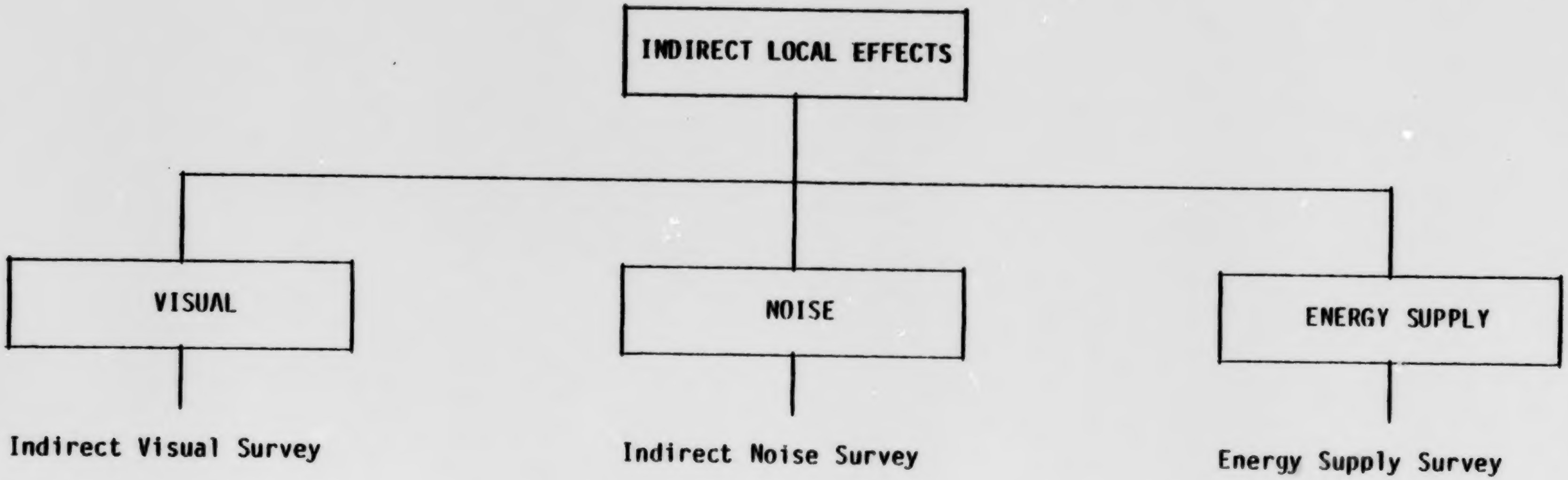

INDIRECT LOCAL EFFECTS
VISUAL
NOISE
ENERGY SUPPLY
Indirect Visual Survey
Indirect Noise Survey
Energy Supply Survey

Figure 4.4
Category Four

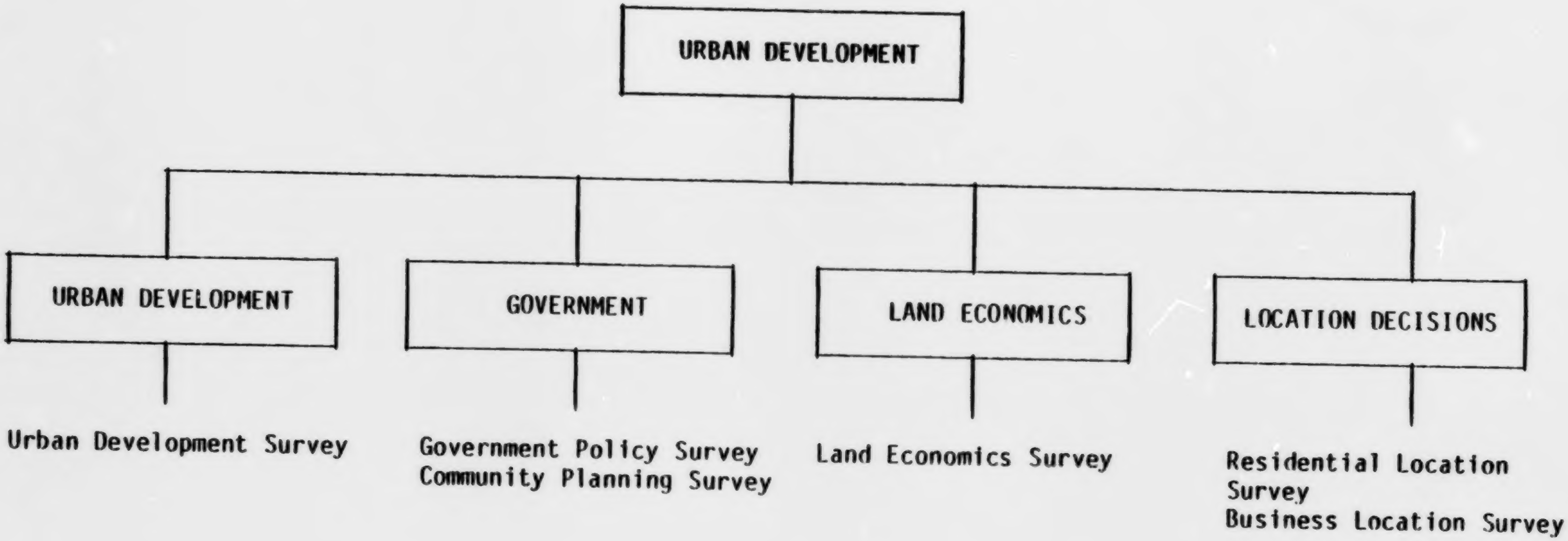

URBAN DEVELOPMENT
URBAN DEVELOPMENT
GOVERNMENT
LAND ECONOMICS
LOCATION DECISIONS
Urban Development Survey
Government Policy Survey
Community Planning Survey
Land Economics Survey
Residential Location Survey
Business Location Survey

Figure 4.5
Category Five

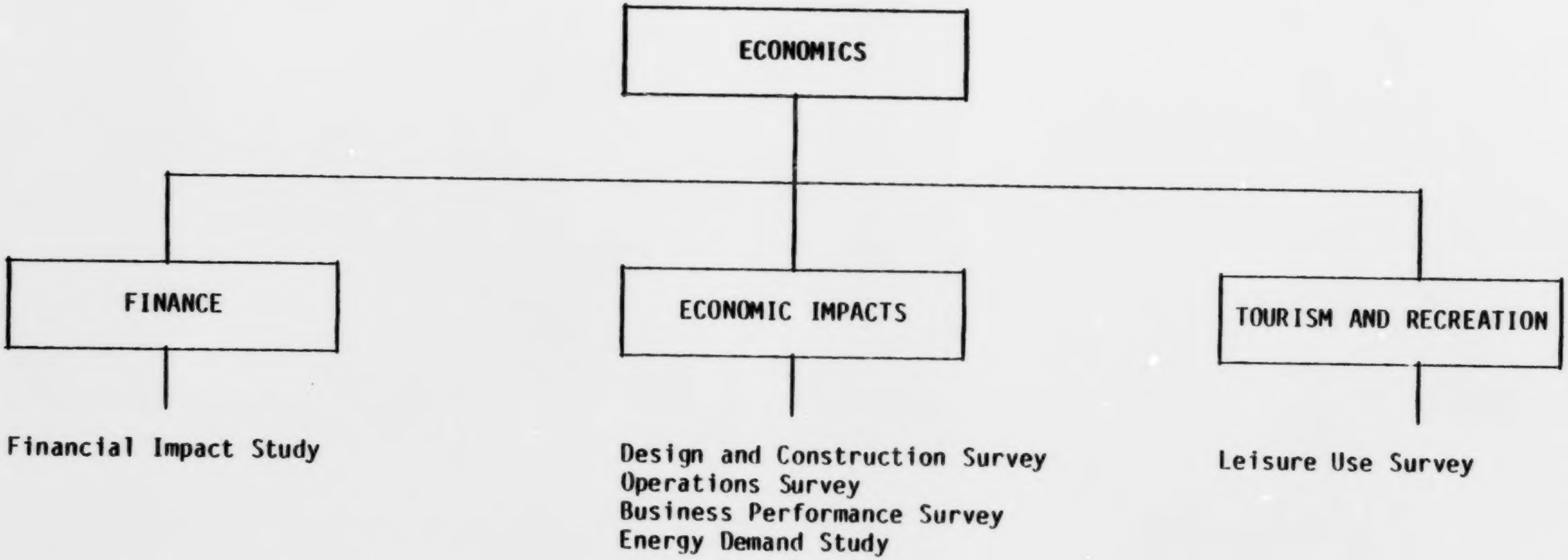

ECONOMICS
FINANCE
ECONOMIC IMPACTS
TOURISM AND RECREATION
Financial Impact Study
Design and Construction Survey
Operations Survey
Business Performance Survey
Energy Demand Study
Leisure Use Survey

Figure 4.6
Category Six

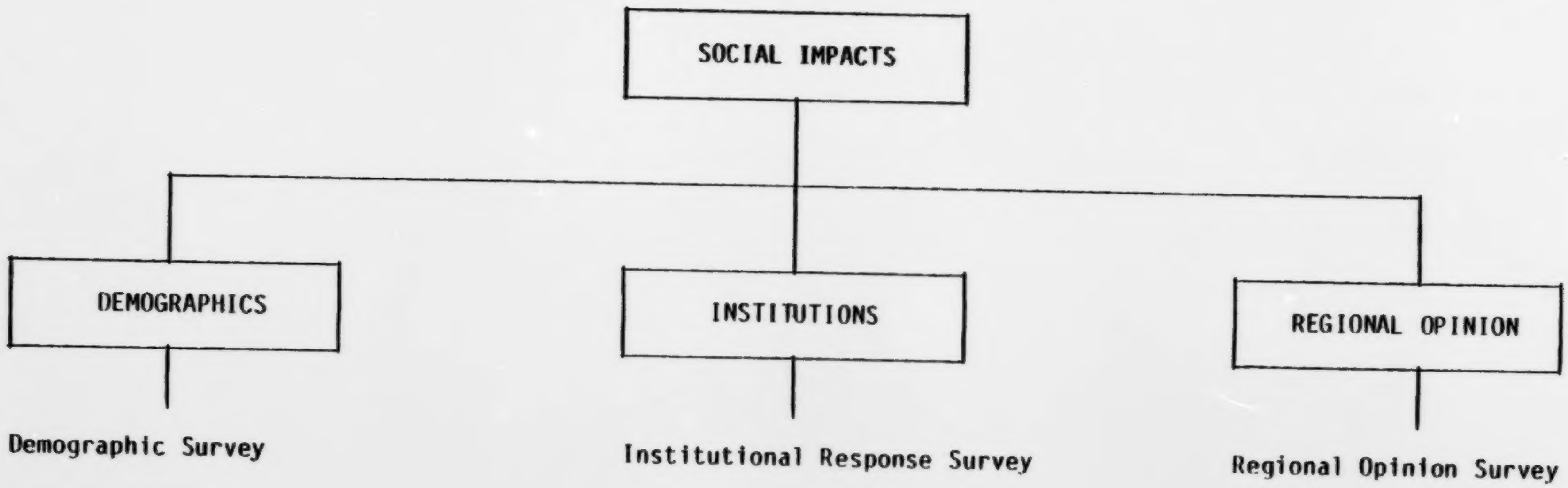

SOCIAL IMPACTS
DEMOGRAPHICS
INSTITUTIONS
REGIONAL OPINION
Demographic Survey
Institutional Response Survey
Regional Opinion Survey

Figure 4.7
Category Seven

2.1 Planning and Construction

This category is designed to provide a separate report on ALRT planning and construction effects. The relevant research tasks could have been included as part of the urban development, economics or environmental categories. However, this category is treated in isolation because it deals specifically with the building of ALRT.

Construction is a short term activity that requires a monitoring program while it is still in progress. Most of the other categories require long term monitoring programs. Including the construction effects with other categories would make it difficult to obtain information on retrospective circumstances, especially initial reactions to the land acquisition program and environmental effects.

Furthermore, since construction comprises an initial stage of ALRT implementation, research tasks will have to be initiated much earlier than those in most of the other categories. Completion of the field work should coincide with the end of the construction phase.

PLANNING AND CONSTRUCTION

SUB-CATEGORY	RESEARCH QUESTIONS
LAND ACQUISITION	1. How much, and what type of land was acquired? 2. How many persons were relocated? 3. How many businesses and residences were displaced? 4. What costs were incurred in the: -expropriation process -negotiation process -railway relocation process -compensation for property intrusion -utility relocation process -other 5. What were the reasons for property selection? 6. What was the community reaction to the land acquisition programme?
ENVIRONMENT	
Noise and Vibration	1. To what extent did construction activities produce significant changes in neighbourhood noise and vibration levels?
Obstructions	1. What was the effect of construction on access to local businesses and residences? 2. What steps were taken to minimize the effects of road closures, utility relocations, detours, removal of on-street parking and other unavoidable construction activities?
BUSINESS	
Retail Sales	1. To what extent was retail performance affected by construction activity? 2. How were businesses affected? 3. What type of business or retail outlet was affected the most by construction activity?

METHODOLOGY	DATA BASE	RESEARCH TASK
-descriptive review; -interviews with: ·property negotiators ·design engineers ·municipal planners ·community groups and associations -mapping; -content analysis.	-land purchase records; -BCT documentation of the land acquisition programme; -minutes of public meetings; -newspaper articles.	Land Acquisition Survey
-descriptive review; -establishment of noise and vibration baseline and monitoring program; -mapping.	-site monitoring results; -photographs of construction activities and problem areas; -monthly construction reports; -Noise Baseline Survey and Noise Monitoring Survey results (refer to Direct Local Effects).	Noise and Vibration Survey
-descriptive review; -interviews with: ·affected parties ·construction schedulers ·municipal officials.	-interview results; -complaints recorded by BCT; -BCT construction records.	Obstructions Survey
-descriptive review of business activity during construction; -key informant interviews of selected retail operators, managers or business owners.	-sales records of selected businesses; -photography; -field checks on construction activities; -key informant interviews; -GVRD land use base maps.	Business Performance Survey

2.2 Direct Local Effects

This category includes several aspects of ALRT in relation to visual and noise effects. Separate reporting on this category is essential since it focuses specifically on direct environmental issues of a local nature.

ALRT will produce several changes to local neighbourhoods and other areas adjacent to the system. Not only will it provide an additional mode of transportation, but the structure itself will add a different dimension to the urban landscape. With an elevated guideway running through residential and other areas, the appearance and character of these areas will take on a new form.

ALRT will also introduce a new source of vehicle traffic and noise through local areas. Noise and vibration from operations are expected to be very low for a rapid transit facility. The extent to which this will have been achieved will be addressed in the final evaluation.

DIRECT LOCAL EFFECTS

SUB-CATEGORY	RESEARCH QUESTIONS
LOCAL OPINION	1. How have residents living near the stations and guideway experienced ALRT presence? 2. To what extent has ALRT influenced residents' perceptions and opinions toward public transportation and specifically ALRT? 3. How have local residents percieved the environmental (or physical) effects of ALRT? 4. Has nuisance parking in residential neighbourhoods that was caused by park and riding activity changed their opinions of the ALRT system?
VISUAL EFFECTS	1. To what extent have ALRT facilities affected the visual character of the surrounding landscape? 2. To what extent has ALRT affected the visual separation of adjacent areas? 3. To what extent have ALRT facilities affected the views from the surrounding areas and views from facilities themselves?
NOISE AND VIBRATION Operations	1. What has been the effect of ALRT operations on the ambient noise in the service corridor, particularly in residental neighbourhoods? 2. To what extent do ALRT operations transmit environmentally significant vibrations?

METHODOLOGY	DATA BASE	RESEARCH TASK
-administer questionnaire to residents situated within 4 blocks of ALRT; and repeat survey every 2 years between 1987 and 1991; -descriptive review of survey results including results of Regional Opinion Survey.	-computer tabulation of Local Opinion Survey results; -results of Regional Opinion Survey.	Local Opinion Surve
-conduct baseline survey: define and map ALRT viewshed; photographic documentation of baseline conditions; -conduct similar survey to document post-ALRT conditions; -descriptive review and evaluation of visual changes using expert judgement and comparative techniques; -conduct audio-visual documentation of the viewshed.	-35mm photography of ALRT viewshed taken before and after construction; -aerial photography before and after construction; -large and smaller scale topographic and land use base maps; -video record of the viewshed.	Visual Baseline Survey Visual Monitoring Survey Visual Assessment Study
-conduct baseline survey: establish monitoring positions for separate and concurrent noise and vibration measurements; measure ambient noise levels over time; -conduct similar survey to document post-ALRT conditions; -descriptive review and evaluation of noise and vibration findings.	-relevant noise studies: 'GVRD, A Community Noise Survey of the Greater Vancouver Regional District', Barron and Assoc., July '71. 'False Creek Noise Study', Barron and Assoc., Apr. '83. Canada Ministry of the Environment has sponsored various airport studies of Vancouver International Airport. 'Waterfront Acoustic Study', Harford Kennedy Wakefield, Sept. '83. -G.V.R.D. land use base maps.	Noise Baseline Survey Noise Monitoring Survey

2.3 Transportation and Travel

This category includes comprehensive and detailed aspects of ALRT travel and transportation effects. This major undertaking is the primary focus of the entire assessment study.

The ways in which ALRT will alter the regional travel picture is the central issue of this category. More specific aspects include the amount of travel in the region, the way travel is done and when and where it occurs. The quality of the travel experience forms an essential part of the picture.

The decision to introduce ALRT was based on the desire for additional public transit capacity in the region. The system is also considered a transportation solution for dealing with future increases in traffic congestion and associated traffic management costs. The extent to which ALRT satisfies these and other objectives will be determined.

TRANSPORTATION AND TRAVEL

SUB-CATEGORY	RESEARCH QUESTIONS
AMOUNT OF TRAVEL	1. What has been the effect of ALRT on the amount of travel in the region? 2. What has been the effect of ALRT on the amount of travel in the service corridor?
TRAVEL PATTERNS	1. Has ALRT influenced changes in travel patterns in the region? 2. Has ALRT influenced changes in travel patterns in the service corridor? 3. What has been the effect of ALRT on parking in the service corridor?
MODE CHOICE	1. What has been the effect of ALRT on modal split in the region? 2. What has been the effect of ALRT on modal split in the service corridor?
LEVEL OF SERVICE	1. What has been the effect of ALRT on the level of service of the transit system and other modes in the region? 2. What has been the effect of ALRT on the level of service of the transit system in the corridor? 3. What has been the effect of ALRT on the level of service of automobiles in the corridor?

METHODOLOGY	DATA BASE	RESEARCH TASK
-administer on-board and station transit ridership surveys; -administer roadside and home interview surveys; -model (re)calibration: ·travel distribution and mode choice model; ·trip generation model; -monitoring of parking activity and traffic re-routing; -descriptive review and evaluation; -statistical and comparative analysis.	-transit ridership counts: on-board ridership counts by time and direction; ridership by bus (train) number, direction, time and load at each station point; -regional traffic volume counts on key collectors and all arterials in the service corridor; -Patron Survey results on travel information; user demographics; opinions on public transportation; factors affecting ridership, etc. -travel distribution, mode choice, and trip generation models; -parking counts and distribution; -road and transit travel time matrix; -origin/destination survey results; -G. V. R. D. land use base maps; -Statistics Canada census information.	Transit Vehicle Ridership Survey Transit Station Ridership Survey Patron Opinion Survey ALRT Corridor Ridership Study Mode Choice Study Traffic Volume Survey Trip Generation Study Corridor Parking Survey

2.4 Indirect Local Effects

This category groups all indirect environmental effects together. Specific noise issues concerning traffic re-routing, etc. could have been absorbed in the direct effects category. Likewise, visual aspects of highrise development are a concern under the urban development category. Both of these issues, however, only warrant a short term monitoring program, and if significant effects are revealed then greater effort will be required.

INDIRECT LOCAL EFFECTS

SUB-CATEGORY	RESEARCH QUESTIONS
VISUAL	1. What has been the visual impact of new highrise developments attributable to ALRT on local residents and businesses?
NOISE	1. What have been the indirect effects of ALRT on the ambient noise level in the service corridor and particulary in residential areas? 2. To what extent have changes in local traffic patterns including increased traffic volumes, new bus routes, park and ride activity, etc. influenced the ambient noise level of residential areas?
ENERGY SUPPLY	1. What has been the effect of the ALRT demand for electricity on the supply of power?

METHODOLOGY	DATA BASE	RESEARCH TASK
-descriptive review of development trends in the service corridor; -document new highrise buildings using photographs taken before and after their development; -descriptive evaluation using expert judgement and community response scores.	-findings of Urban Development Study; -photography collected for the Visual Impact Survey; -key informant interviews with local residents and business proprietors; -Local Opinion Survey results.	Indirect Visual Survey
-descriptive review: ·noise level changes; ·changes in local traffic patterns.	-noise measurement data taken from the Noise and Vibration Survey; -MTOC records on bus changes; -information on park and ride activity, both planned and unplanned.	Indirect Noise Survey
-descriptive review of existing and future energy requirements for ALRT and power supplied by B.C. Hydro.	-B.C Hydro energy consumption records; -key informant interviews with electrical designers of ALRT and B.C. Hydro officials; -MTOC/BCT energy consumption statistics on ALRT.	Energy Supply Survey

2.5 Urban Development

This category deals with specific aspects of ALRT in relation to land use and urban development effects. The system has influenced land use changes by occupying a relatively large area in the region.

In response to the ALRT transportation decision a number of planning policies have been implemented to accommodate anticipated change in the urban fabric. Land use policies in relation to station nodes have been amended in some of the municipal plans to reflect increased land use density. These and other aspects of urban development and redevelopment are an integral part of this category.

URBAN DEVELOPMENT

SUB-CATEGORY	RESEARCH QUESTIONS
URBAN DEVELOPMENT Land Use	1. What has been the effect of ALRT on business and residential development, particularly near the station areas?
	2. What has been the effect of ALRT on building density?
	3. What has been the effect of ALRT on business and residential redevelopment?
	4. Have ALRT noise and vibrations been a significant factor in shaping development near the guideway and stations?
	5. Have re-zoning and land use amendments (including air rights) been a significant factor in shaping development near the guideway and stations?
	6. Has ALRT contributed to development changes of crown lands and agriculture land reserves (ALR) in the Lower Mainland?
	7. To what extent has ALRT influenced development and investment decisions?
	8. To what extent has ALRT influenced joint development by the public and private sectors?
	9. How has ALRT affected the centralization or decentralization of jobs and resident labour force in the region?
	10 To what extent has ALRT affected the implementation of the Liveable Region concept?
GOVERNMENT	1. In which way have various governments responded to planning and development opportunities presented by ALRT?
	2. To what extent has the development of ALRT influenced community and local area planning in the municipalities of Vancouver, Burnaby and New Westminster?
	3. How has the ALRT transportation decision influenced government policy implementation?

METHODOLOGY	DATA BASE	RESEARCH TASK
-descriptive review and evaluation: ·number and type of new developments and redevelopments; ·regional development trends using control areas and ALRT market area; ·air rights and issues over the guideway and suburban stations; ·municipal zoning and land use amendents; ·noise and vibration zone in relation to development patterns; ·crown land and ALR issues; ·property investment strategies based on interviews with prime developers and investors; -administer interviews.	-Vancouver Real Estate Board sales data by area and time period; -Statistics Canada records by census tract or the same statistics through G. V. R. D. land use data base; -city zoning maps and composite reports produced from time to time. -G. V. R. D. land use base maps; -development applications and permits, re-zoning approvals, and business licence permits from various muncipal departments; -noise measurement data from the ALRT Noise and Vibration Study; -key informant interviews with developers and possibly with members of the Building Owners and Managers Assoc.; -B. C. Assessment Authority statistics; -ALR and crown land policies. -interviews with major employers in the region.	Urban Development Study
-descriptive review and evaluation: ·regional and municipal official planning policies before and after ALRT; ·regional and municipal zoning and land use amendments; ·business development incentives i.e. mortgage assistance, etc. provided by various governments; ·compatibility of ALRT transit related developments with official plans. -administer interviews.	-G. V. R. D. and municipal zoning and land use policies; -G. V. R. D. land use mapping; -key informant interviews with planners, aldermen and active citizens in the planning of ALRT; -committee and public meeting minutes; -BCT plans for bus facilities, new bus loops, etc. in the ALRT service corridor.	Government Policy Survey Community Planning Survey

URBAN DEVELOPMENT

SUB-CATEGORY	RESEARCH QUESTIONS
LAND ECONOMICS	1. What has been the effect of ALRT on property values in relation to guideway and station proximity? 2. To what extent has ALRT influenced speculation activity? 3. What has been the effect of ALRT on property and business taxation, particularly near the stations? 4. Has ALRT influenced property ownership changes in areas near the guideway and at stations? 5. What has been the effect of ALRT on property development in the region and specifically within the service corridor? 6. What has been the effect of ALRT on residential supply and demand in the region and specifically within the service corridor?
LOCATION DECISIONS Residence and Work Place	1. To what extent has the availability of ALRT influenced residential location decisions? 2. To what extent has the availability of ALRT influenced workers' job locations?
Business	1. What has been the effect of ALRT on business location decisions?

METHODOLOGY	DATA BASE	RESEARCH TASK
-descriptive review and evaluation: ·real estate transactions in the service corridor since 1976; ·speculation "cycle" near ALRT based on an interview program; ·property value and developement changes in regional control areas and ALRT market areas; ·municipal taxation changes in ALRT market area and control areas; -multi-variant statistical analysis; -possible use of the Dewees regression model to assess ALRT's effect on residential values.	-Vancouver Real Estate Board land sales records; -B.C. Assessment Authority statistics on property sales, values, ownership, etc.; -Municipal business licence and tax records; -key informant interviews with real estate agents and known speculators.	Land Economics Study
-descriptive review: ·home interview results (i.e. reasons for residential and work location decisions); ·shifts in socio-economic patterns in service area; ·changes in housing costs and availability.	-Vancouver Real Estate Board records; -B.C. Assessment records; -results of 'newcomer' survey; -Statistics Canada census information.	Residential Location Study
-descriptive review: ·interviews with new business owners and managers; ·changes in the number and types of businesses within the service corridor.	-municipal business licence records; -key informant interviews with real estate agents and commercial building landlords; -Vancouver Real Estate Board records; -G.V.R.D. Commercial and Industrial Floor Space system.	Business Location Study

2.6 Economics

This category includes the effects of ALRT on capital financing, employment, business and energy consumption. The costs and funding of ALRT will be a primary source of concern since the system has been a major financial commitment by the Province of B.C.

The extent to which ALRT is a cost-effective component in the regional transportation system will be the central issue in the final evaluation.

ECONOMICS

SUB-CATEGORY	RESEARCH QUESTIONS
FINANCE Funding	1. How was the system funded? (i.e. Federal grants, Provincial and local tax, local user charge, British Columbia Development Corporation loans, etc.)
	2. What was the impact of ALRT capital financing on all public transit systems in B.C.?
	3. What has been the impact of ALRT on provincial and local taxation?
	4. What are the future sources of ALRT funding?
Costs	1. What were the costs of the design, construction, initial operations and operations after 1 year, 2 years,...6 years?
	2. What are the provincial tax policies related to ALRT?
	3. How do ALRT costs compare to the costs of an alternative system?
	4. What has been the effect of ALRT on transit bus operating costs?
	5. What hs been the effect of ALRT on automobile operating costs?
Revenue	1. What were the revenue projections for ALRT ?
	2. What revenue has been generated through taxation and the fare box?
ECONOMICS Design and Construction Employment	1. What direct employment was generated by the design and construction?
	2. What was the proportional employment contribution by greater Vancouver, B.C., Canada, and elsewhere?
	3. What indirect employment was generated? (i.e. suppliers of raw materials, etc.)
	4. How were the basic and non-basic industries in the Lower Mainland affected by ALRT construction?
	5. To what extent has ALRT construction affected industries outside the region?

METHODOLOGY	DATA BASE	RESEARCH TASK
-descriptive review: ·financial statements on funding, revenues, costs and tax sharing; ·provincial transit tax policies and budget; ·bus transit costs and automobile costs on service corridor; -descriptive analysis of ALRT costs compared to the costs of an all bus and auto scenario.	-B.C.T. financial statements on ALRT design, construction, operations and maintenance; -MTOC fare profiles on ALRT; -tax collection and financial reports produced by or for BCT; -provincial transit tax policies; -provincial transit budget; -municipal capital works projects before and after ALRT; -cost estimates on an all bus and automobile system in lieu of ALRT.	Financial Impact Study
-multiplier analysis; -trendline analysis.	-BCT employment and payroll statistics; -BCT and MCL records on the costs and supplies of materials; -G.V.R.D. employment/labour force model (cohort survival model); -BCT's list of firms directly and indirectly employed in ALRT construction.	Design and Construction Employment Survey

ECONOMICS

SUB-CATEGORY	RESEARCH QUESTIONS
Operations Employment	1. What direct employment has been created for system operations and maintenance?
	2. What indirect employment has been created for system operations and related support services?
	3. How have ALRT operations and maintenance contributed to the basic and non-basic industries in the Lower Mainland?
	4. To what extent have industries outside the region been affected by ALRT operations?
Business	1. What has been the effect of ALRT on retail sales, particularly in station areas?
	2. What has been the effect of ALRT on shopping patterns?
	3. To what extent have business activities changed in the ALRT market area?
Energy Use	1. What have been the energy requirements for ALRT operations?
	2. What has been the effect of ALRT energy consumption on the transportation system including buses and automobiles?

METHODOLOGY	DATA BASE	RESEARCH TASK
-multiplier analysis; -trendline analysis; -descriptive review of ALRT employment compared to the NO-ALRT employment scenario.	-BCT employment and payroll statistics; -BCT's list of service and supply industries.	Operations Employment Survey
-administer interviews; -descriptive review of business profits, volumes, etc.; -comparison of retail performance in the ALRT market area with control areas.	-interview results from selected retail owners or managers in ALRT service area and control areas; -sales and business performance records from selected businesses in the corridor and control areas.	Business Performance Survey
-description: ·ALRT energy requirements for each passenger carried, per passenger kilometer, etc.; ·ALRT energy use consumption and costs compared to an all bus or auto scenario; ·ALRT's contribution to the total energy consumption and costs of the transportation system; -administer interviews.	-BCT statistics on ALRT and bus energy consumption; -ALRT ridership estimates; -ridership projections and energy use estimates for an all bus and auto system; -B. C. Hydro energy consumption records; -interviews with ALRT electrical designers and B. C. Hydro officials.	Energy Demand Study

ECONOMICS

SUB-CATEGORY	RESEARCH QUESTIONS
TOURISM AND RECREATION	
Tourism	1. What portion of ALRT ridership lives outside the Lower Mainland region and why are they using ALRT? 2. What portion of non-regional ridership use ALRT primarily for sightseeing or recreational purposes? 3. What portion of ALRT revenue was generated by tourist use?
Recreation	1. What portion of resident (Lower Mainland) ridership use ALRT primarily for recreational purposes? 2. To what extent has the availability of ALRT changed travel patterns between downtown Vancouver and various suburban areas for social/recreational, or leisure activities? 3. What was the effect of ALRT on leisure activity and broadening leisure spending? 4. What portion of ALRT revenue was generated by local recreational use?

METHODOLOGY	DATA BASE	RESEARCH TASK
-descriptive analysis of patron survey (i.e. tourist and recreational use); -descriptive review; ·yearly tourist and recreational ridership trends; ·seasonal variations and user demographics; ·ALRT revenue sources; ·sales performance statistics of sample tourist enterprises; ·provincial tourist trends; -administer interviews.	-tourist and local trip statistics from patron survey; -key informant interviews with travel agents and tourist bureau managers; -"Visitors '79, B.C. Travel Survey", Canada-Provincial effort, June '80; -possible survey of patrons in resturants, clubs, etc. to obtain information on their travel mode, trip origin, etc.	Leisure Use Study

2.7 Social Impacts

An important aspect of any transportation system is the way in which people perceive and use it. As a new system in the region, ALRT is expected to enhance mobility. This has numerous implications for people's travel behaviour, travel patterns and lifestyle.

This category is specifically created to provide a focus for the social effects of ALRT. Socio-economic issues covered in other categories will be assembled in this report along with specific research recommended for this category.

SOCIAL IMPACTS

SUB-CATEGORY	RESEARCH QUESTIONS
DEMOGRAPHICS	1. What has been the effect of ALRT on the socio-economic profile of communities located near the stations? 2. To what extent has ALRT influenced the lifestyle of people who live within the service corridor? 3. To what extent has ALRT influenced the travel behaviour of people who live within the service corridor, particularly near station areas?
INSTITUTIONS	1. Has ALRT influenced any changes in the demographic profile of various local institutions such as churches, community associations, etc., located within the service corridor?
REGIONAL OPINION	1. What has been the effect of ALRT on the publics' opinion and attitude towards public transportation and specifically ALRT?

METHODOLOGY	DATA BASE	RESEARCH TASK
-descriptive review and evaluation of Patron and Local Opinion survey results: ·shopping, visiting and social patterns; ·changes in mobility for elderly, youth, etc.; ·changes in travel behaviour (i.e. travel frequency, mode choice, etc.); -trendline analysis of demographic trends in RDS's* near ALRT and control areas.	-Statistics Canada or G.V.R.D. census data bases; -G.V.R.D. land use data base; -Local Opinion Survey results.	Demographic Survey
-key informant interviews -comparison between selected institutions inside and outside ('control' samples) the ALRT corridor; -descriptive review; -membership statistics where possible.	-results of ALRT Patron survey; -results of ALRT Local Opinion survey; -key informant interviews with senior members of selected institutions.	Institutional Response Study
-conduct and administer regional opinion survey; -descriptive review of survey results from ·Local Opinion; ·Patron; ·Regional Opinion; -descriptive evaluation of opinions in relation to ALRT proximity, frequency of use and demographics.	-results of ALRT Regional Opinion Survey; -results of ALRT Local Opinion survey and Patron survey; -G.R.V.D. land use base maps; -Statistics Canada census information.	Regional Opinion Survey

*G.V.R.D. residential development sub-areas.

3.0 TECHNOLOGY ASSESSMENT

The technology assessment includes system documentation and performance evaluation. These topics will be combined in a separate final report. General research questions, methodologies and data requirements associated with each are identified in the following.

3.1 System Documentation

The documentation will provide a detailed description of the specific technologies and design characteristics. Technological features such as the steerable trucks, automatic train control and linear induction motors provide the main focus of this project.

3.2 System Performance Evaluation

The purpose of the evaluation is to compare actual performance with design expectations. Appendix A outlines some of the more important design specifications and service standards. The key criteria for the evaluation are as follows:

a) Function and safety
b) Reliability
c) Maintenance performance
d) Manufacturers' support
e) Environmental provisions (i.e. drainage, electrical ground leakage, electromagnetic compatibility, noise, soil disturbance, etc.)
f) Energy consumption
g) User quality characteristics

The automated control system requires particular attention since service reliability is completely dependent on its performance. In addition, the evaluation will include any deficiencies or shortcomings of the design.

TECHNOLOGY ASSESSMENT

SUB-CATEGORY	RESEARCH QUESTIONS
DOCUMENTATION	1. What are the special technologies of the ALRT system and how have they been used? 2. What quantity of materials and building technologies were used during the construction/manufacturing phase? 3. What are the functional and spatial characteristics of the ALRT system? 4. How has the ALRT system been maintained? 5. What safety and security provisions have been employed? 6. What are the system quality characteristics from a user perspective? 7. How much energy has been consumed by the system annually and by various components in the system?
PERFORMANCE	1. How has the ALRT system performed against all design specifications? 2. How have design standards that established ALRT's ride and service qualities fared against patron's experiences and opinions?

METHODOLOGY	DATA BASE	RESEARCH TASK
-descriptive documentation of: ·technologies ·construction ·manufacture ·spatial and functional characteristics ·maintenance ·safety and security ·ride quality ·energy consumption -key informant interviews with operations officals.	-system manuals; -as built and construction reports; -materials testing reports; -manufacturer's reports.	ALRT System Documentation Survey
-evaluate and compare design performance with documented performance; -undertake special performance measurements where maintenance or documentation is deficient; -employ descriptive and statistical analysis to verify reliability of performance data; -evaluate system quality characteristics from the user perspective.	-System Documentation Survey including: ·maintenance ·operations ·as builts -ALRT Patron Opinion Survey.	ALRT System Performance Study

4.0 IMPLEMENTATION PROCESS

The implementation process is described under three headings: alternative scopes, deliverables and management. The function of the steering committee and alternative management options are discussed in the study management section.

4.1 Alternative Study Scopes

This section describes three alternative scopes for the study. Each is divided into three parts: Impact Assessment, Technology Assessment and Study Management. The topics included under each and those omitted, are detailed in Part 2 and Part 3. Table 1 provides a summary of each alternative. It is anticipated that the initial analysis for some research tasks will suggest early termination of several monitoring programs without significantly influencing the quality of the analysis and conclusions. Other tasks may require longer monitoring programs.

4.1.1 Full Scope Study

This scope reflects the amount of effort required to ensure a comprehensive and scientifically credible impact study. It includes seven impact categories and a technology assessment.

Monitoring programs may be carried out over a 10 year period. This will ensure that most of the longer term effects can be detected. Experience in San Francisco, Toronto and other North American cities suggests that many of the urban development and transportation impacts do not properly manifest themselves until well past the 5th year of operations.

The construction phase is featured as an impact category. Such a study has not been undertaken before. Its inclusion will add to the body of knowledge on impacts and fulfill the study objective of comprehensiveness.

4.1.2 Intermediate Scope Study

This scope is similar to the full scope except for the removal of the construction category and a possible reduction in the study period to eight years.

The monitoring programs are those most affected by this. With fewer points of measurement some impacts may remain undetected. In such cases the full extent of measurable impacts would be poorly documented.

The flexible nature of the study, however, permits the extension of any monitoring program considered deficient. Five impact categories and a technology assessment are included.

FULL SCOPE

Impact Assessment:

1. Effects of Planning and Construction
    - Land Acquisition Documentation
    - Environmental Issues
    - Business Issues
2. Direct Local Effects
    - Visual Issues
    - Noise Issues
    - Public Opinion Feedback
3. Effects on Transportation and Travel
    - Ridership and Patron Issues
    - Traffic and Travel Behavior Issues
4. Indirect Local Effects
    - Visual Side Effects
    - Noise Side Effects
    - Energy Issues (Supply)
    - Safety and Security Issues
5. Effects on Land Use and Urban Development
    - Urban Development Issues
    - Government Policy Issues
    - Land Economics
    - Location Decisions
6. Economic and Financial Effects
    - Financial Issues
    - Employment Aspects
    - Business Performance Aspects
    - Tourism and Recreation Aspects
    - Energy Use Impacts (Demand)
7. Social Effects
    - Demographic Characteristics
    - Institutional Effects
    - Regional and Local Opinion Feedback

Technology Assessment:

8. System Documentation and Performance Evaluation

INTERMEDIATE SCOPE

Impact Assessment:

1. Direct Local Effects
    - Land Acquisition Documentation
    - Visual Issues
    - Noise Issues
    - Public Opinion Feedback
      (Public Opinion Program Cutback)
2. Effects on Transportation and Travel
    - Ridership and Patron Issues
    - Traffic and Travel Behavior Issues
      (Reduced Monitoring)
3. Effects on Land Use and Urban Development
    - Urban Development Issues
      (Reduced Monitoring)
    - Government Policy Issues
    - Land Economics
    - Location Decisions
4. Economic and Financial Effects
    - Financial Issues
    - Employment Aspects
    - Business Performance Aspects
    - Energy Issues (Demand)
    - Tourism and Recreation Aspects
5. Social Effects
    - Demographic Characteristics
    - Institutional Effects
    - Regional and Local Opinion Feedback
      (Reduced Monitoring)

Technology Assessment:

6. System Documentation and Performance Evaluation

MINIMUM SCOPE

Impact Assessment:

1. Direct Local Effects
    - Visual Issues
    - Noise Issues
    - Public Opinion Feedback
2. Effects on Transportation and Travel
    - Ridership and Patron Issues
      (Reduced Monitoring)
    - Traffic and Travel Behaviour Issues
      (handled by using existing transport models and evaluations partly undertaken by others). No additional monitoring is included.
3. Effects on Land Use and Urban Development
    - Urban Development Issues
    - Government Policy Issues
    - Land Economics
    - Location Decisions (Reduced Monitoring)
4. Economic and Financial Effects
    - Financial Issues
    - Employment Aspects
    - Business Performance Aspects
    - Energy Issues (Demand)

Technology Assessment:

5. System Documentation and Performance Evaluation

STUDY MANAGEMENT (Common to all alternatives:)

A. **Technical Function**

- Synthesis and Evaluation of Technical and Research Reports to Produce:
    1. Committee Reports
    2. Technical Reports
    3. Final/Interim Final Reports
    4. Summary Reports
    5. Audio-Visual
    6. Contract Implementation

B. **Administration Function**

1. Annual Reports
2. Quarterly Progress Reports
3. Contract Administration and Coordination
4. Client Reports

C. **Data Management**

1. Centralized Data Management
2. Data Access and Identification System

Table 1 Alternative Study Scopes

4.1.3 Minimum Study Scope

This scope reflects a significant reduction in the quality and comprehensiveness of work. Several study categories have been completely removed with the result that the scientific credibility of the study, including the use of state-of-the-art research techniques, would be compromised.

Most of the major impact issues would still be addressed using less effective techniques. This alternative represents a minimum effort below which the study objectives will require redefinition. Only four impact categories and a technology assessment are included.

4.2 Deliverables

The study has been described in terms of a series of documentation and evaluation research tasks that, when combined, form the foundation of the study. This section identifies the types of products (reports and/or documents) which will be delivered (refer to Table 2). A preliminary work schedule that outlines the full scope of the study is illustrated in Figure 5.

4.2.1 Audio-Visual

Two audio-visual (video tape) summary presentations of the entire study will be produced. They will each be 10-15 minutes in length. One will deal with the ALRT technology and the other with the impacts of installing and operating the system. These tapes will be produced after the Final Reports have been approved.

4.2.2 Summary Report

Two summary reports will be produced: one for the Impact Assessment and one for the Technology Assessment. These reports will be produced after the Final Reports have been approved.

The style of the summary reports will address the widest audience possible given the nature of the subject matter.

4.2.3 Final Report

A two-volume Final Report will be produced. Volume 1 will deal with the Impact Assessment and Volume 2 will deal with the Technology Assessment.

The Final Report will contain a concise record of all significant findings, conclusions and methodologies, and a summary of background data and support documentation.

The Final Report will be completed on the assumption that no further work will be undertaken. The interim Final Reports, on which this will be based, should include estimates of future (not yet measured) impacts so that the Final Report contains the total impact.

YEAR (APPROX.)	IMPACT ASSESSMENT STUDY (Intermediate Scope)	TECHNOLOGY ASSESSMENT STUDY
1991	Audio/Visual	Audio/Visual
1991	Summary Report	Summary Report
1991	Final Report	Final Report
1988	Interim Final Report	
1986-91+	Study Reports . by category and/or sub-category	
1984-90+	Research Reports . by documentation and/or evaluation research tasks (technical)	Research Report
1983-85	Research Task Design/ Terms of Reference	Research Task Design/ Terms of Reference
1984-91+	Client Reports	
1984	STUDY DESIGN	

ADMINISTRATIVE REPORTS

1. Annual Reports - 1984-1991
2. Quarterly Reports - throughout study
3. Financial Report and Budget Estimate - Annual

Table 2 Deliverables

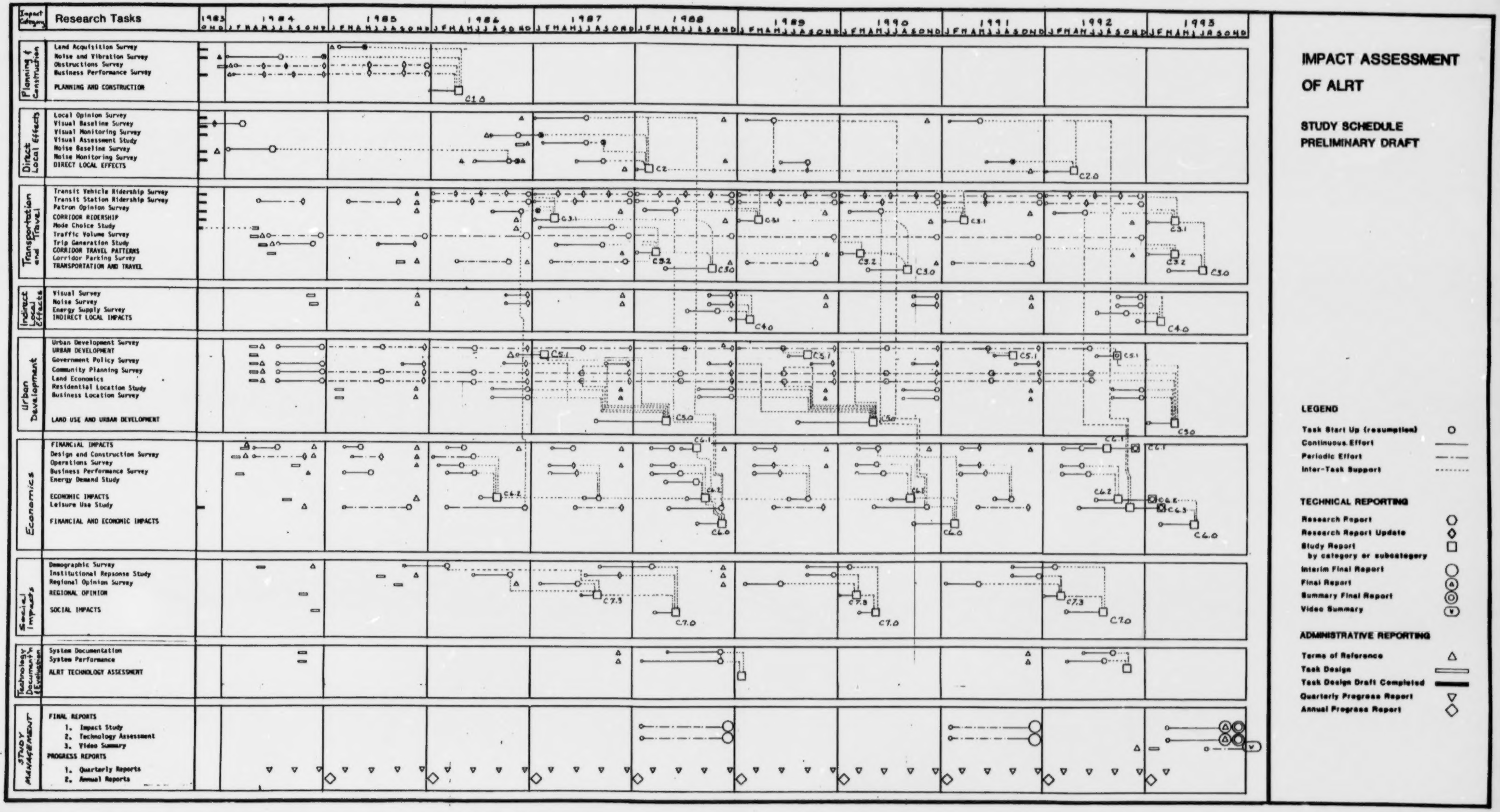


Figure 5
Preliminary Work Schedule

4.2.4 Interim Final Report

The approach to producing the interim Final Report is identical to the Final.

This report will contain all conclusions and requisite background documentation for all tasks chartered for the study. All supporting study reports and reports on research tasks will be brought to an interim conclusion. Details will be provided on the need for further work on those monitoring programs (research tasks) considered to be incomplete. Those tasks not requiring any further monitoring or evaluation will be recommended for termination.

4.2.5 Study Reports

Several study reports will be completed as major products of the study. Each study report will focus on a specific impact category or sub-category. In most cases two or more reports will be produced for any given category/sub-category to permit the interim Final Report to be prepared.

The study reports will contain technical information with subject treatment not deliberately simplified for an unfamiliar lay readership.

4.2.6 Research Reports

All research reports are based on research tasks. They will focus on a specific data collection, monitoring program or evaluation. Research tasks will be produced as research reports during each year where significant work is undertaken including monitoring programs that are repeated each year.

The purpose of the research report is to keep up to date the work in progress or completed, for each of the documentation and/or evaluative tasks. The purpose, however, is more than "keeping up to date" - the reports should contain a complete and exhaustive account of all work undertaken.

4.2.7 Client Reports

From time to time the client or the project manager will initiate an updated review of the study to enable new directions and/or recommendations to be addressed. To facilitate this process the project manager will prepare a client report which summarizes the research to date and presents recommendations and/or clarification of the current issues in the study program.

4.2.8 Task Design

Guidelines for preparing research task designs can be found in Appendix C. An example of a completed research task design is contained in Appendix D.

4.2.9 Administrative Reports

Progress reports will be issued by the study administrator on a quarterly basis. At the end of each calendar year a more detailed report, highlighting the work over the past twelve months, will be produced.

4.3 Study Management

For budgeting and organizational purposes the responsibilities to be performed by study management have been divided between three broad functions.

		% of total effort
1.	Technical Function	64%
2.	Administrative Function	11%
3.	Data Management Function	20%

Table 3 illustrates two similar management options best suited to this study. The functions have been further detailed along with man years of effort and the proportional level of effort for each function.

The extreme management options of either BCT or a consultant taking on the entire study management responsibility have been deliberately excluded. With total B.C. Transit responsibility the study would appear to lack objectivity and could be the target of considerable criticism. With all responsibilities entrusted to a consultant there would be little doubt about objectivity, but B.C. Transit would suffer from a lack of control and participation in the study.

The two alternatives given in Table 3 form a useful compromise by the division of responsibilities between B.C Transit and a consultant. The major difference between them is the responsibility for data management.

4.3.1 Steering Committee

A five member review committee has been appointed. The purpose of this committee is to review all products generated by the study and to offer suggestions and guidance to the commissioning agencies (B.C. Transit and the Transportation Development Center).

Figure 6 shows the relationship between the various participants of the study. The steering committee performs an advisory function. The academic and citizen provide independent representation and one member represents local government. The committee will be augmented by an expert(s) from time to time.

AGENCY		BCT	Prime Consultant	BCT	Prime Consultant
Function	%				
1. Technical 64%					
. Eval. Res. Reports	4		X		X
. Analysis and Task Designs	20		X		X
. Study Reports and Client Reports	20		X		X
. Final/Interim Final Reports	20		X		X
2. Administration*					
. Terms of Reference	5	X		X	
. Tendering	1	X		X	
. Contract Admin. (Coordination, monitoring)	9	X		X	
. Progress Reports	1	X		X	
3. Data Management	20	X			X
* BCT in consultation with other funding agencies					
	100%	36%	46%	16%	84%
Full Scope	13.0	4.5	8.5	2.0	11.0
Intermediate Scope	10.0	3.5	6.5	1.5	8.5
Minimum Scope	8.0	2.5	5.5	11.0	7.0
(units in man years)					

Table 3 Study Management Options

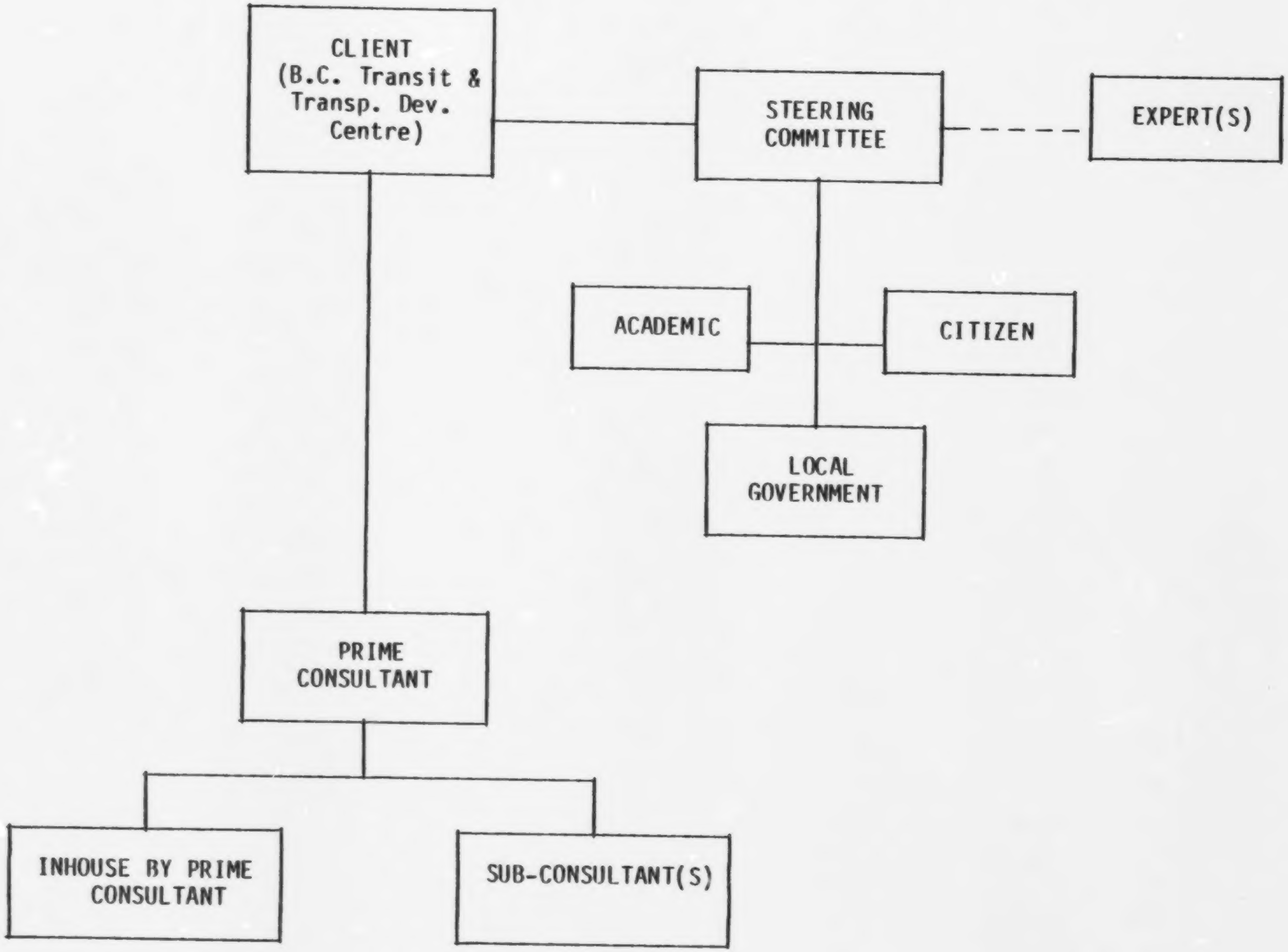

CLIENT
(B.C. Transit &
Transp. Dev.
Centre)
STEERING
COMMITTEE
EXPERT(S)
ACADEMIC
CITIZEN
LOCAL
GOVERNMENT
PRIME
CONSULTANT
INHOUSE BY PRIME
CONSULTANT
SUB-CONSULTANT(S)

Figure 6
Study Participants

The prime consultant has the responsibility of performing all the work required for the study. This also involves assigning tasks to sub-consultants.

The steering committee has the following members:

Mr. Larry Ward - B.C. Transit;
Mrs. Ling Suen - Transportation Development Center;
Mr. Ken Cameron - Greater Vancouver Regional District;
Dr. John Morrall - University of Calgary; and
Mrs. Hilda Symonds - Local Planning Advocate.

APPENDIX A ALRT Specifications, Service Standards and Projected Ridership

1.0 ALRT SPECIFICATIONS

The following specifications are taken from the B.C. Transit publication, "Advanced Light Rapid Transit - The System for Greater Vancouver".

Start of project:	May, 1981
Start of construction:	March, 1982
Completion of line:	December, 1985
Start of revenue service:	January, 1986
Delivery of last vehicle:	June, 1986

Length of system, phase one: 21.4 km
(Subject to adjustment during detailed design)

At grade:	6 km
Elevated:	13 km
Underground:	2 km

Guideway

At grade:	Continuously reinforced concrete slab 20 cm (8 in) thick.
Elevated:	Trapezoidal beam cross-section, precast and pre-stressed concrete.
Width:	Double-track guideway beam 6.5 metres (21.3 feet).
Depth:	Single guideway beam 1.9 metres (6.2 feet).
Normal Span Length:	Approximately 30 metres (100 feet).

Track

Continuously welded standard gauge, 1.435 metres, (4 feet 8 1/2 inches) 52.3 kg (115 lb) steel rail.

Vehicles: 114 initially

Length:	12.7 metres (41.7 feet)
Width:	2.4 metres (8.0 feet)
Height:	3.13 metres (10.3 feet)
Weight:	13,000 kg (28,600 lbs)
Capacity:	Normal maximum - 75 (40 seated, 35 standing) Crush Loading - 90 (40 seated, 50 standing)
Cruise speed:	72 kmh

Construction:	Welded aluminum frame and skin, fibre glass end caps. Honeycomb aluminum roof and honeycomb bimetal floor.
Power:	600 volts direct current collected from two aluminum rails with stainless steel caps. Power is converted on each car to variable frequency, variable voltage three-phase AC for the linear motors.

Train control

Based on the SELTRAC moving block concept of Standard Electrik Lorenz (ITT Canada) the system consists of three computer systems.

The system management centre is a single computer which, under the direction of a human operator, carries out supervisory functions such as scheduling, rerouting, system startup and shutdown emergency procedures and so on.

The vehicle control centre consists of three linked computers with responsibility for safe train movement. It communicates with each train and receives instructions from the system management computer.

The third element is the vehicle on-board computer which receives and verifies commands from the vehicle control computer and issues safe instructions for propulsion and braking, doors, couplers, etc.

Stations: Fifteen

Two underground, five at grade and eight elevated underground and elevated stations will have escalators and elevators or ramps.

1.1 SERVICE STANDARDS

SYSTEM CAPACITY

LINE CAPACITY (passengers in the peak direction)

Stage	Peak Hour	Peak 10 min
Initial	11,000	2200
Year 2000 a)	25,000	5000
Guideway	30,000	

STATION DESIGN (Two way movement in/out during peak hour (approx. 80% in peak direction) c)

Station	Movements
WATERFRONT	6-8,000
BURRARD	11-13,000
GRANVILLE	6-8,000
STADIUM	9-11,000
MAIN	4-6,000
BROADWAY	10-12,000
NANAIMO	1-2,000
29th STREET	1-2,000
JOYCE	2-3,000
METROTOWN	4-6,000
ROYAL OAK	2-3,000
EDMONDS	3-4,000
22nd STREET	3-4,000
NEW WESTMINSTER	4-6,000
BRUNETTE*	3-4,000
LOUGHEED*	3-4,000
SCOTT RD*	6-8,000

Notes:

a) Installed system capacity
b) Without major rebuilding of fixed facilities.

*Future Extension

TRAVEL TIMES

RUNNING TIME (excluding station dwell time) a)

WATERFRONT – BROADWAY	10 min
WATERFRONT – DWNTWN NW	28
NEW WESTMINSTER – SCOTT RD	5
NEW WESTMINSTER – LOUGHEED	8

FREQUENCY OF TRAINS b)

Time	Period	Headway
WEEKDAYS		
5:30- 6:30	Service Build-up	7.5-2 min
6:30- 8:30	AM Peak Period	2
8:30- 9:30	Reduce to Base	2.5
9:30-15:00	Base Service	5
15:00-16:00	Service Build-up	5-2
16:00-18:00	PM Peak Period	2
18:00-19:00	Reduce to Even	2-5
19:00-27:30	Evening Service	5-7.5
22:30- 2:00	Owl Service	7.5
SATURDAY		
6:00- 8:30	Service Build-up	7.5-5
8:30-19:00	Base Service	5
19:00- 2:00	SAME AS WEEKDAYS	
SUNDAYS/HOLIDAYS		
6:00- 9:30	Service Build-up	7.5-5
9:30-22:00	Base Service	5
22:00- 1:00	Owl Service	5-7.5

Notes:

a) Scheduled running times on alignment shown in section 5.3, excluding the time trains are stopped in stations
b) Preliminary, subject to detailed service specification by BC Transit

COMFORT

RIDE QUALITY

Air Quality: Vehicle design should provide 20-30 full cycles of filtered air/hour with up to 100% outside air

Temperature: 18° C or ambient, whichever is higher under normal operating condition

Interior Noise: 65-68 Dba

Lighting: At least 320 lux @ avr. sitting to standing height inside car and 200 lux @ low level in doorways using soft neon lighting.

Seating/Standing: Each vehicle should have comfortable seating for 28-32 passengers @ 4 m²/passenger and space for 47-50 standees with hand holds @ 25 m²/passenger.

Loading: For purposes of preparing ALRT service specifications GVRD will use 80 passengers/car as a design capacity.

Cleanliness: Interior materials should facilitate keeping vehicles neat and clean with minimal maintenance

Provision for Disabled: Vehicle layout should provide for use of the system by the disabled.

Special Needs: Vehicle layout should provide for parcel storage and should enable some use of the system by bicyclists.

Sustained Accelleration/Jerk Limits

MOVEMENT	ACCELL	JERK
Sideways	100 g	05 g/s
Up-Down	100 g	05 g/s
Forward-Back	137 g	10 g/s

Roll/Pitch/Yaw (Straight Guideway)
2.0 degrees/second

Vibration: Vehicle vibration limits should be the same as or less than other Light Rail vehicles operating in Canada

Electro-Magnetic Emission: The system should be designed so that there are no substantial complaints by an outside party

STATION COMFORT (See Appendix for Specifications)

RELIABILITY

SYSTEM FAILURES

The system should be designed, built, tested and commissioned to provide failure free operation for 98% of all scheduled service hours, where a "system failure" is defined as an unscheduled stoppage of one or more cars on the revenue service track for more than 2 minutes, including unscheduled delays in stations.

Failures due to passenger-caused interruptions, vandalism, natural catastrophies, objects on the guideway, deliberate stoppages and other failures caused by factors outside the operating system would not be counted as system failures.

EQUIPMENT RELIABILITY

At the time the system is fully accepted by the operator, trains, power system, train control systems, fare collection equipment and other parts of the operating system should, meet or exceed standards of reliability for other Canadian light-rail systems as follows.

- Hours of operation between failure or overhaul,
- Proportion of vehicles in service vs out of service for maintenance or repair;
- Hours of Normal vs. Impaired and Failed operation

OPERATIONS/MAINTENANCE

1) At the time the system is fully accepted by the operator, it should have been demonstrated to run in fully automatic mode without motor-men while meeting other standards described in this figure
2) Operating and maintenance costs (excluding operator salaries and benefits) as well as maintenance time/hour of in service operation, should be equal to or less than other Canadian Light Rail Systems

SAFETY/CONVENIENCE

SAFETY

Fire: Car bodies and interior, and fixed facilities should be designed and tested to meet current fire standards for Canadian rapid transit systems and appropriate local codes.

Security:

1) Closed circuit TV surveillance of all public areas on the system
2) Operating and staffing plan should be designed and tested to provide less than two minute response time by security officers to any location on the system

Guideway Protection: Fixed facilities should be designed to minimize the likelihood of people or foreign objects getting on to the guideway

Boarding/Alighting Safety:

1) Standard and emergency door opening and emergency stop procedures should maximize passenger safety
2) Gaps between car and station platform should be 8 cm or less
3) Platforms and door openings should be designed and lit to maximize boarding and alighting safety

Emergency Egress:
System design should safeguard passengers and operating personnel from

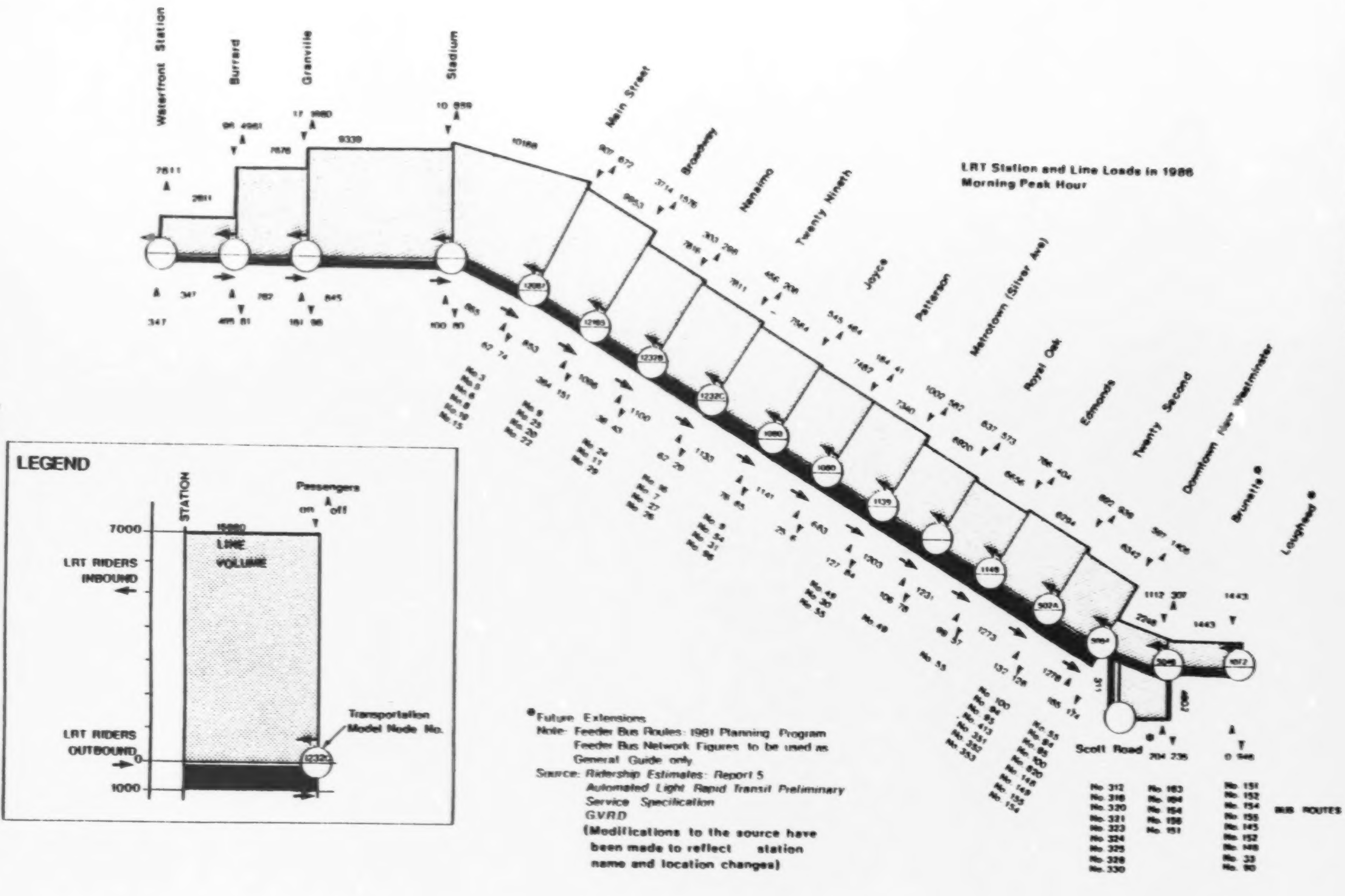
- Moving trains
- Live power
- Falling or tripping

CONVENIENCE

1) Station Design to provide access
2) Full Fare Integration
3) Schedule Integration with buses
4) Overall System Information

aken from Report 5 – Automated Light Rapid Transit, Preliminary Service Specification, G.V.R.D.

1.2 MID 1980's RIDERSHIP



LRT Station and Line Loads in 1986
Morning Peak Hour

● Future Extensions

Note- Feeder Bus Routes: 1981 Planning Program
Feeder Bus Network Figures to be used as
General Guide only

Source: *Ridership Estimates: Report 5*
Automated Light Rapid Transit Preliminary
Service Specification
GVRD
(Modifications to the source have been made to reflect station name and location changes)

APPENDIX B Baseline Conditions, Impact Measurement and Conceptual Framework

The following outlines the theoretical basis for the study design.

'Impact' connotes significant change. In order to evaluate an impact, changes must be carefully measured. This raises the question, "what portion of measured change in the environment can be attributed to ALRT and how can this change be measured?"

To provide a reasonable answer to this question the notion of baseline was introduced. Different baselines were examined to determine the most practical one. Examples of baselines were defined within the context of the ALRT. Moreover, a conceptual framework was formulated to provide the foundation for developing a study design for an impact problem.

1.0 BASELINE CONDITIONS

A base condition reflects the 'normal' condition which would exist in the absence of a new transportation facility. There are several conditions which may be used as baselines. Figure 1 illustrates three possible baselines for land rent at time t_1, and an actual measure of land rent with ALRT in service at the same time t_1. By comparing land rent values between the actual (curve "r") and the estimated baselines ($BL_0 ... BL_2$) an approximation can be made of the impact or change that is related to ALRT. With this in mind, four possible definitions can be identified by which relative change is estimated.

Impact definition No. 1: $\Delta = r - BL_2$

Compare actual land rent with that estimated if an alternate technology delivered an equivalent level of service. Measured differences are considered the result of the unique qualities of the ALRT technology (i.e. fixed rail, quietness, reliability, convenience, etc.). A clear and consistent definition of 'level of service' would be necessary before any comparison could be made with the ALRT technology.

Impact definition No. 2: $\Delta = r - BL_1$

Compare actual land rent with that estimated if use of the existing technology (buses) followed the regional growth trend in transit service development. Measurable differences include both the effects of an enhanced level of service as well as those intangible qualities which distinguish ALRT technology from alternate technologies.

Impact definition No. 3: $\Delta = r - BL_0$

Compare actual land rent with that determined to exist prior to ALRT implementation, say at time t_0. Differences measured include the total changes which have occurred in this time period $t_0 - t_1$. Thus all market conditions acting to change land rent are included; not just those changes attributable to ALRT.

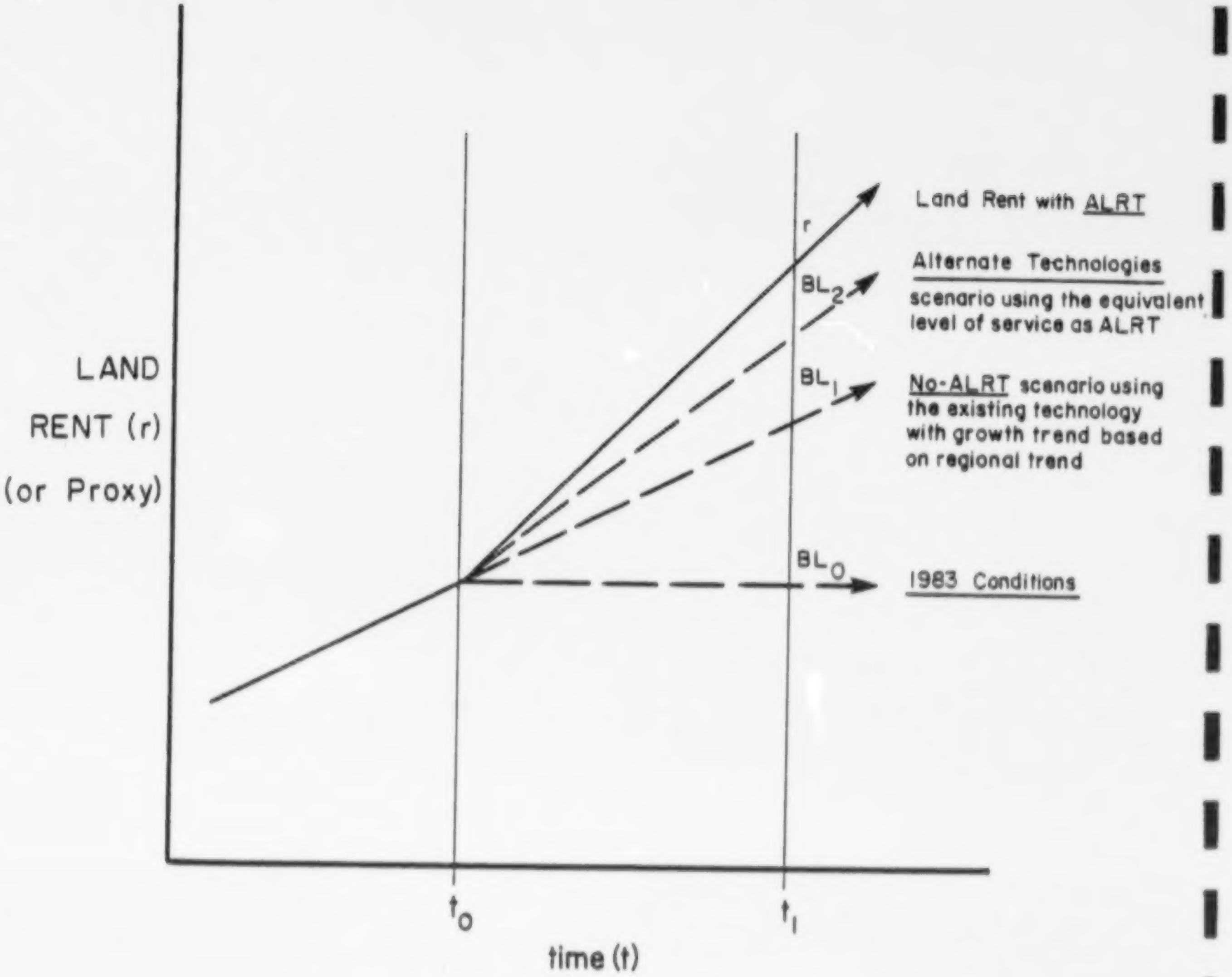


Figure 1

Alternate Baseline Definitions

Impact definition No. 4: $\Delta = BL_2 - BL_1$

Compare the effects of two levels of transit service. The first, BL_2, is the ALRT equivalent service and the second, BL_1, is the No-ALRT which uses existing technology. As an illustration of this more theoretical comparison, it is supposed that BL_2 would be defined as any transit technology, however, the unique characteristics that might distinguish ALRT from competing and equivalent technologies would presumably be excluded. Thus the BL_2 baseline might be compared with BL_1 from a purely transport capacity perspective. Such a comparison would require mean values and 'typical' weights given to the factors that describe the level of service provided by BL_2, against the likely scenario for the bus-only (No-ALRT) BL_1 baseline. Rational definitions would need to be given to the terms 'equivalent transit service' and 'transport capacity'.

Although most impact studies use BL_1 as a base it has two major drawbacks that must be considered. BL_1 must be simulated, usually with a model, which requires expensive model calibration. Additionally, most land use and development changes due to the transportation facilities are related to the re-allocation of activities within a region rather than new investments and activities. This tends to create unstable baseline conditions in other transportation corridors.

For the purposes of this study the concept of BL_1 will be used as a baseline. The actual recorded baseline conditions, however, will be obtained for parallel corridors and nodes of development. Future ALRT corridors and other nodes can be used as controls for measuring changing conditions (given a measure of development, if it occurs, for average non-ALRT conditions). This will also enable a fairly concise definition of BL_1 in the ALRT corridor.

The competing baseline definitions have serious drawbacks that preclude their use. In Figure 1 the $(r - BL_2)$ condition seems appealing since it compares similar levels of service where the only apparent difference would be the inherent qualities that distinguish ALRT from an alternative rapid transit technology. This approach has serious shortcomings since the objectives of the study are to document and evaluate ALRT and not to speculate on a competing technology that has not been selected. The exercise of comparing ALRT with an untried (in Vancouver) competing technology forces the researcher to make assumptions that may strongly bias the evaluation. Moreover, the extra expense of designing and costing such an alternative scenario places a serious budgetary constraint on this approach.

The $(r - BL_0)$ definition offers a simple approach to measurement, but it completely discounts the major changes that could occur over time, and which are primarily the result of broad market conditions. Even adjusting cost values for inflation does not address the myriad of market factors that will undoubtedly mark significant changes from the 1983 base condition. The results of this approach would generally exaggerate the positive (or negative) impacts of ALRT and be misleading.

The (BL_2 - BL_1) condition does not even address the concept of impact as defined, that is, that impact must reflect the changes that can be reasonably attributed to ALRT. This baseline definition involves only the changes that relate to a common increase in the level of service without considering the specific qualities unique to the ALRT technology. If this approach is taken then much of the research must rest with simulation modelling to approximate both the BL_2 and BL_1 condition. The difficulty in developing the BL_2 scenario has already been noted.

The (r - BL_1) definition, while moderately difficult to measure, offers the best combination of theoretical soundness and reasonable cost. The results will reflect a useful comparison between the new system and the No-ALRT alternative.

1.1 IMPACT MEASUREMENT

Impact will be measured in two ways:

1. The change from a baseline condition using, where practical, the changes observed in a parallel or 'control' location. This will be designated as an objective impact. It will reflect documented changes based on physical measurements.
2. The difference between the measured value of the impact (objective) and the criterion measure of a community standard. For example, the level of noise experienced near an access route to an ALRT station compared with a community standard noise level, say an Leq of 55 dBA. This can be referred to as a subjective impact.

Each impact type will be considered on its own and, to some extent, by its interrelationship with other impacts. It should be emphasized that the impact evaluation will not include a study of remedies or mitigation procedures. Some impacts can be expressed only in qualitative terms and evaluation will be made by consensus and/or expert judgement.

Baseline Measurement Context

Various spatial characteristics of impacts and affected groups must be defined clearly and identified within the context of ALRT.

1. There is a need to differentiate between line sections and station sections as illustrated in Figure 2 following.

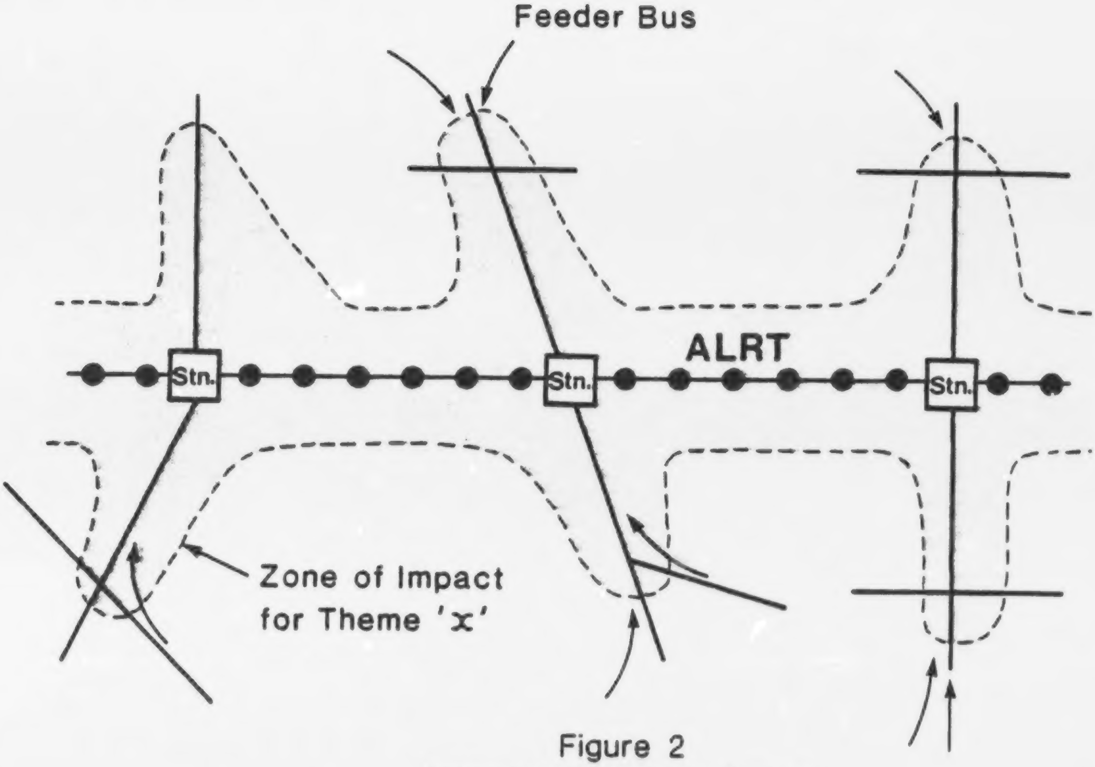


Figure 2
Impact Influence Areas

For example, direct and indirect impact influence areas may be of a different character and affect different groups at stations and along the guideway. Stations may create an 'active' change with development to station nodes. The line itself is merely a 'passive' influence which may or may not be disruptive in its effect.

2. Proposed stations along the route should be classified into development types such as town centre, commercial strip (along access routes), residential/green park, the CBD, the Sea-Bus (major dispersal point) and B.C. Place Stadium.

3. Existing residential neighbourhoods and their social composition should be identified and delineated. Baseline measures need to be designed to enable neighbourhood disruption and other effects to be determined. A similar definition of commercial areas is required.

4. Impact zones should be categorized into those which have severe, moderate and slight impacts.

5. Major access streets may experience indirect effects far removed from ALRT stations. The spatial extent of these potential influences needs to he defined.

1.2 CONCEPTUAL FRAMEWORK

The concept of impact provides the basis for formulating a conceptual framework for the study design. Figure 3 illustrates the complexities involved. The diagram shows all the dimensions of an impact problem and their interrelationships. For the purposes of this study, the three major dimensions. affected groups, impact categories and measurement scale provide a framework within which areas of impacts may be identified and data collection, data management and future data analysis conducted.

The 'impact category' dimension contains a range of broad impact areas such as transportation, economics, urban development, etc. which require investigation. Each category can be divided into sub-categories with greater detail; each representing a slice of the broader impact issue. Under transportation, for example, specific sub-categories would be travel patterns and mode choice.

The 'affected groups' dimension recognizes that impacts effect various groups differently. Groups identified would include users, non-users, corridor residents, community and commercial organizations and other users. Depending on the impact, these groups would be categorized according to those most affected by the impact issue.

The 'measurement scale' dimension refers to the intensity and extent of the impact itself. The intensity will be qualified wherever possible by either objective measurement and/or community response scores derived from a subjective impact assessment. The extent of the impact will be expressed in units such as numbers of persons, housing units, etc. in conjunction with the duration of the effect.

The initial research question, as illustrated by the cell structure in Figure 3, represents the starting point for the evaluation of an impact. The research question can indicate a certain relationship with one or more impact categories, along with affected groups and methods of analysis. When refined the question serves as a guide to the monitoring and evaluation of identified impacts. The impact can be measured in units of change or deviation from a standard or criterion.

This study design ends at the initial research question stage. Initial question(s) for each impact category indicate further areas for investigation based on data requirements and methods of analysis. In order to answer these questions a number of specific research tasks or projects must be undertaken. At this level, the questions, methods and data are further refined in a detailed study design. The study design reflects an iterative process that can be followed at any level of detail.

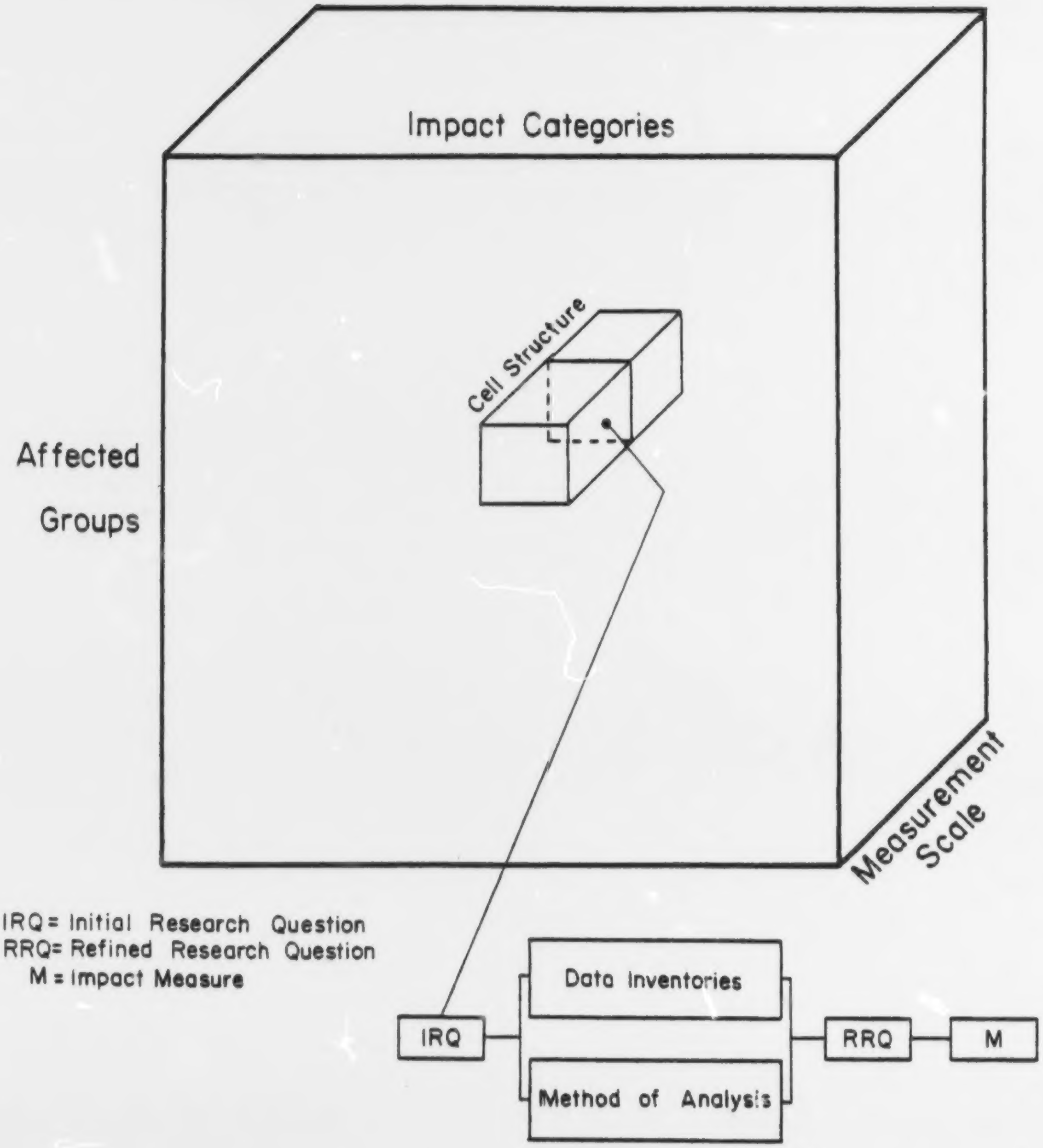

Impact Categories
Cell Structure
Affected Groups
Measurement Scale
IRQ= Initial Research Question
RRQ= Refined Research Question
M = Impact Measure
Data Inventories
IRQ
RRQ
M
Method of Analysis

Figure 3

Conceptual Framework

APPENDIX C Guidelines for Preparing Research Task Designs

Research Task Title

1.0 BACKGROUND

The background shall present information which will aid the researcher in understanding the reasons for undertaking the task as well as describing the general environment that surrounds it. Assumptions, predictions or hypotheses may also be introduced in this section.

2.0 OBJECTIVES

A clear and concise statement of the nature, purpose and extent, or scope of the task as well as an indication of the anticipated product.

3.0 REFINED RESEARCH QUESTIONS

Research questions must query the central issue(s) that is stated or implicit in the objective. They must be clear, testable (answerable) and compatible with the data and methodologies available.

4.0 WORK TASK FEATURES

This section shall outline the data requirements and anticipated products of the task to help define the scope and the level of effort required for completion. In most cases it will contain detail not included in the statement of objectives thus forming a bridge between the brevity of the objectives and the greater levels of detail to be found in the methodology and data sections.

5.0 METHODOLOGY

The methodology shall outline a specific course of action including a description of analytical techniques (if known), measurements and data collection activities. In most cases, research is an iterative and dynamic process which permits corrections and updates of the methodologies being used. For this reason the methodology must describe a "most likely" course of action and not an "itinerary" of specific task activities unless they are known and very likely to be undertaken without significant modification. In all cases the methodology is a suggested approach and any equivalent or improved technique can be incorporated during task implementation.

6.0 DATA

The data requirements shall be discussed under 'Methodology'; however, a summary of confirmed, useful data sources shall be listed in this section. This shall include data to be collected or monitored as well as existing data available from other agencies. The term 'data' is used with its broadest meaning (i.e. books, articles, computer files, surveys, maps, photographs, etc.).

7.0 TIME FRAME

The recommended start-up and the duration of the task should be estimated as accurately as is practical.

8.0 TOTAL COST ESTIMATE

A breakdown of yearly cost estimates shall be included in addition to the total cost.

9.0 CONTRACTOR

This identifies the type of expertise required to accomplish the work task. In some cases, the data collection and other task activities require services provided by government agencies. In these instances such agencies shall be identified.

APPENDIX D A Sample Research Task Design: Visual Baseline Survey

A consistent organizational approach for all research topics and research task designs is essential in maintaining continuity over the time to be covered by the Impact Assessment Study. Consequently, guidelines for research task designs that cover the approach, structure, level of detail and reporting format have been prepared and are presented as Appendix C.

This Appendix presents the completed research task design for the visual baseline survey as an illustration of the application of these guidelines.

On the basis of this design, the first data collection program was completed in the fall and winter of 1983-84. The research report that marks the completion of that data collection effort is presented as Appendix E.

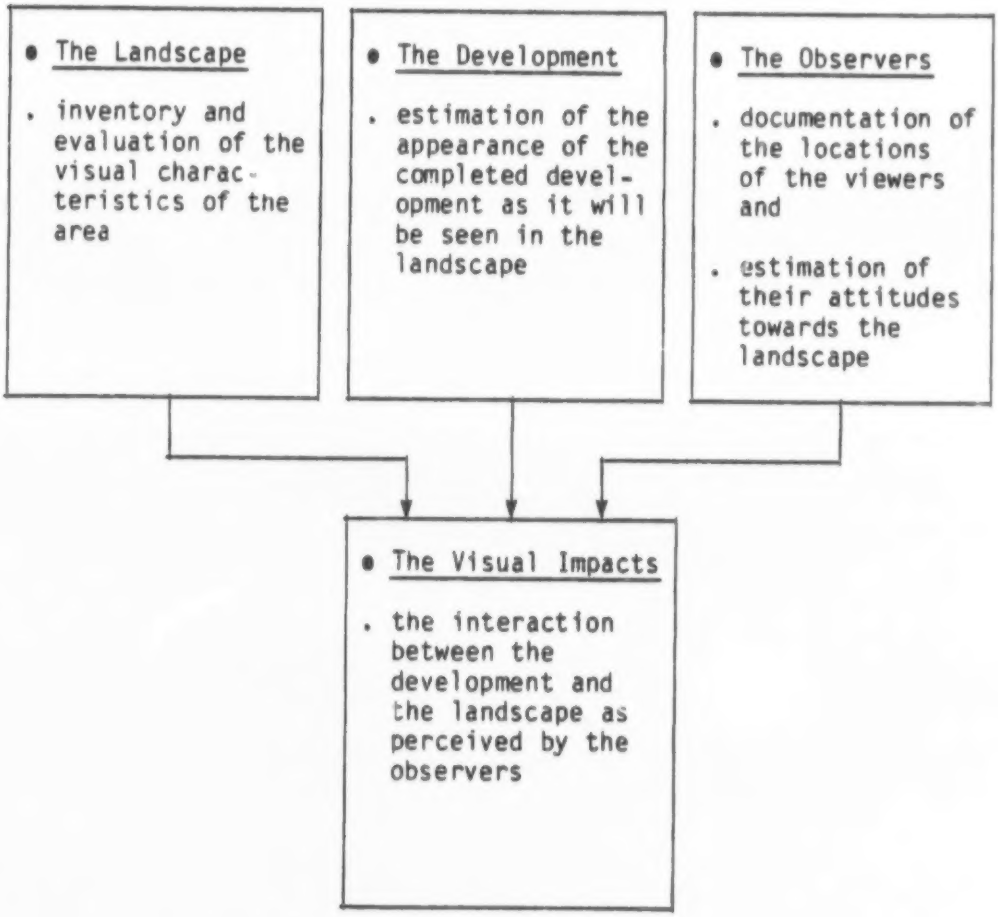
A SAMPLE RESEARCH TASK DESIGN

VISUAL BASELINE SURVEY

1.0 BACKGROUND

Visual impact assessments are studies whose primary objective is to determine whether a proposed development will result in significant changes in the character of the areas in which it will be built or in the views from adjacent areas.

The various elements usually considered in the evaluation of visual impacts are:



- The Landscape
  - inventory and evaluation of the visual characteristics of the area

- The Development
  - estimation of the appearance of the completed development as it will be seen in the landscape

- The Observers
  - documentation of the locations of the viewers and
  - estimation of their attitudes towards the landscape

- The Visual Impacts
  - the interaction between the development and the landscape as perceived by the observers

2.0 OBJECTIVES

The objective of the Visual Assessment Study is:

- to document and evaluate the changes in the visual environment related to ALRT facilities.

The objectives for the first phase of the study, the Visual Baseline Survey are:

- to review the visual assessment literature;
- to prepare a detailed design for the Visual Assessment Study; and
- to document the visual character of the ALRT corridor prior to the start of construction of the guideway in the fall of 1983.

3.0 RESEARCH QUESTIONS

The research questions that will guide the development of a detailed design for the visual assessment study are:

1. To what extent has the visual character of the surrounding landscape been affected?
   Some of the areas that should be investigated are:
   - How well do ALRT facilities fit into the landscape in terms of line, form, texture, color and scale?
   - To what extent has the visual separation of adjacent areas been affected?
   - To what extent, and how effectively, have landscaping treatments such as linear parks been employed?

2. To what extent have viewing opportunities been affected?
   Some of the topics that should be investigated are:
   - To what extent have views from the surrounding areas been affected?
   - To what extent have new viewing opportunities been provided by ALRT?

3. To what extent has privacy been affected?
   One of the topics that should be investigated is:
   - Views into back yards and residences from elevated trains.

4. To what extent has solar access been affected?
   Some of the topics that should be investigated include:
   - Which areas are affected by shadows cast by ALRT facilities?
   - How do the shadow patterns vary throughout the year?

5. What are the most effective methods of documenting the visual environment?

6. What are the most effective methods for the assessment of visual impacts?

7. What is the spatial extent of the ALRT viewshed?

8. Which areas in the ALRT viewshed could be the most sensitive to changes in the visual environment due to ALRT?
   - This question should address possible visual/acoustical substitution/interaction effects.

4.0 WORK TASK FEATURES

The key elements of the Visual Baseline Survey should be:

- review of pertinent literature relating to visual assessment;
- preparation of a detailed design for the Visual Assessment Study that will include phasing with specific research questions and objectives for each phase as well as a general statement of the most probable methods of analysis;
- selection of photographic techniques that will yield products suitable for the most probable analysis methods;
- photographic documentation of representative areas within the ALRT viewshed before construction of the guideway begins in the fall of 1983;
- development of a storage and retrieval system for the photographs; and
- preparation of a research report following the completion of the survey.

5.0 METHODOLOGY

The Visual Baseline Survey should include, but not necessarily be limited to, the following:

- a review of pertinent literature relating to visual assessment and preparation of a summary report with bibliography;
- mapping of the viewshed of the ALRT;
- selection of photographic equipment (i.e. the camera-lens combination) and field techniques on the basis of careful research into appropriate photographic methods for visual assessment;
- use of conventional colour negatives and colour transparencies;
- developoment of a sampling program that will permit generalization to all areas within the ALRT viewshed;
- documentation of conditions within the viewshed prior to the start of construction by obtaining ground-level colour photographs of the various areas along the route as well as black and white vertical aerial photographs of the entire corridor;
- accurate recording of the location of all camera stations used to document the initial conditions as well as the time of year and time of day of photography so that the differences between the "before" and "after" photographs can be minimized;
- evaluation of baseline photographs to ensure that the images are of acceptable quality;
- preliminary analysis of photographs to refine the analytical procedures and identify areas in which additional photographs may be required; and
- organization of all photographs into a logical, easy-to-use filing system.

6.0 DATA

In this section of the research design a data collection program is suggested on the basis of the data needs for a visual assessment study, the data available and the probable costs of collecting new information.

6.1 Data Needs

Experience has shown that maps, large scale aerial photographs and ground-level photographs are essential for visual analysis. The maps and aerial photographs should be of sufficient scale to clearly show all relevant detail but should also be presentable in standard report format. Black and white aerial photos, at scales of 1:5,000 to 1:10,000, that are obtained prior to the onset of construction in the fall of 1983 should be used.

Colour ground-level photographs should be used to document the changes in the visual environment.

6.2 Data Sources

Maps and photographs of the Vancouver area and the ALRT corridor are available from several sources at a variety of scales. Table 1 lists the maps, Tables 2 and 3 list the air photos and air photo products and Table 4 lists the ground-level photographs. These and other possible sources should be further evaluated before data collection commences.

6.3 Data Collection Program

A base map covering the ALRT Corridor from the Waterfront Station to the New Westminster Station should be assembled. The visual status of the corridor prior to the start of construction should be recorded using black and white vertical aerial photographs. A photomosaic should also be prepared for use in the inventory and analysis phases as well as for illustrating the project. Ground-level colour photographs should be obtained from a variety of carefully selected camera stations throughout the viewshed.

7.0 TIME FRAME

The literature review and detailed study design must be completed as soon as possible so the baseline survey can be conducted prior to the beginning of guideway construction in the fall of 1983. The preliminary analysis of photographs of baseline conditions and the evaluation of photograph quality should also occur in the fall of 1983 to ensure that any additional photography can be completed.

8.0 TOTAL COST ESTIMATE

Phase I - Visual Baseline Survey	$ 42,000.00

9.0 CONTRACTOR

Study Manager

MAPS OF THE ALRT CORRIDOR

SCALE	DATE	TITLE	COVERAGE	SOURCE, CONTENT, ETC.
1:25 000	79.	Greater Vancouver Street Map	City of Vancouver	GVRD Drafting Dept. . SL-179 Sheet 1 . street names, legal boundaries, 10' contours . very clear map
1:25 000	72.	Military City Map	Vancouver Area	Geological Survey of Canada . cultural info. out of date
1:10 000	79.	Greater Vancouver Street Maps	City of Vancouver	GVRD Drafting Room . several sheets . good maps
1: 6 000	82.	ALRT System Description	ALRT Corridor	B.C. Transit
1: 2 500	81.	Metro Land Use Series	GVRD	GVRD Drafting Dept. . land use in approx. 12 categories . many sheets . to be updated Fall '83
1: 1 000	83.04	ALRT General Plans	ALRT Corridor	B.C. Transit . 1/2 size set of 1:500 series
1: 500	83.04	ALRT General Plans	ALRT Corridor	B.C. Transit . 109 sheets . alignment plan & profile, coordinate grid, buildings and trees
1: 500	81.10	Topography	ALRT Corridor	Pacific Survey Corp. . no alignment shown
1: 500	79.	Topography and Utilities	ALRT Corridor	GVRD Engineering Dept. . to go with 1:500 photo mosaics

Sources

- GVRD Engineering Dept., 2294 W. 10th Ave., (731-1155) - Frank Flintoff
- GVRD Planning Dept., 2034 W. 12th Avenue, (731-1155) - Colin
- Geological Survey of Canada, 100 W. Pender Street
- B.C. Transit, 700 W. Pender Street (683-8401) - Ian Graham
- Pacific Survey Corp., (683-6501) - Bill Calder

Table 1 Maps of the ALRT Corridor

AERIAL PHOTOGRAPHS FOR THE ALRT CORRIDOR

SCALE	DATE	FORM	COVERAGE	SOURCE, CONTENT, ETC.
1:60 000	82.	B & W	Lower Mainland	Maps B.C.
1:20 000	79.04	B & W	Lower Mainland	Maps B.C.
1:10 000	79.	B & W	Lower Mainland	Maps B.C.
1: 6 000	82.03	B & W	City of Vancouver	Nadir Mapping
1: 4 200	78.03	B & W	ALRT Corridor: Vancouver to Trout Lake	Burnett Resource Surveys . 84 photos
1: 4 200	76.07	B & W	ALRT Corridor	Burnett Resource Surveys . 105 photos
1: 4 000	82.03	B & W	ALRT Corridor: Downtown Vancouver	Nadir Mapping . 26 photos
1: 3 000	81.10	B & W	ALRT Corridor	Nadir Mapping . IRP 2459 and 2460 . flying height 1500-1600 ft. ASL
No scale	83.02	Oblique color negatives	ALRT Corridor: . Burnaby & NWr	Donald E. Waite . helicopter views of various station areas

Sources

- Maps B.C., Ministry of Environment, Victoria, B.C. (387-1441) - Gordie Harris
- Nadir Mapping, 310 Water Street, P.O. Box 2278, V6B 3W5 (681-3505) - Andy Taylor
- Burnett Resource Surveys, 2973 Lake City Way, Burnaby, B.C. (420-2600) - Pat Wong, Dave Dickson
- B.C. Transit Rapid Transit Team, 1055 Dunsmuir, Bentall 4, Suite 874 (683-8401) - Sandra Brennan

Table 2 Aerial Photographs of the ALRT Corridor

AIR PHOTO PRODUCTS FOR THE ALRT CORRIDOR				
SCALE	DATE	FORM	COVERAGE	SOURCE, CONTENT, ETC.
1:20 000	79.04	Mylar Mosaic	ALRT Corridor: Central Park to New Westminster	GVRD Library and Maps B.C. . PM 396-79, Mosaic of Sandheads, Douglas Is.
1: 2 000	81.10	Mylar Enlargements	Station Locations	GVRD Engineering Dept.
1: 500	81.	Mylar Mosaic	Station Locations	Pacific Survey Corp. . enlarged from 1981 1: 3 000 set
1: 500	79.	Mylar Mosaic	ALRT Corridor	GVRD Drafting Dept. . 51 sheets . overlays available . not scale corrected

Sources

- Pacific Survey Corp., 1409 W. Pender Street (683-6501) - Bill Calder
- GVRD Planning Dept., 2034 W. 12th Avenue (731-1155) - Colin
- GVRD Engineering Dept., 2294 W. 10th Ave. (731-1155) - Frank

Table 3 Air Photo Products For the ALRT Corridor

GROUND-LEVEL PHOTOGRAPHS OF THE ALRT CORRIDOR

FORM	DATE	NO. OF PHOTOS	COVERAGE	SOURCE, CONTENT, ETC.
Color Slides 35 mm	'81-'83	3000+	Various areas	B.C. Transit . house demolition . prebuilt section . not structured
Color Slides 35 mm	'83-'83	150	Sections F & G	FENCO LAVALIN CORP. Dave Johnson . views from the line every 100 m
Color Slides 35 mm	'82		Vancouver Section of ALRT	City of Vancouver . problem-oriented

Sources

- B.C. Transit, Rapid Transit Team, 1055 Dunsmuir, Bentall 4, Suite 874, (683-8401) - Bob Egby, Sandra Brennan
- City of Vancouver, Planning Dept. - Kent Smith

Table 4 Ground-Level Photographs of the ALRT Corridor

APPENDIX E A Sample Research Report: Visual Baseline Survey

This Appendix marks the completion of the Visual Baseline Survey, the first of two data collection programs for the Visual Assessment Study. It describes the types of data and methods of data collection as well as the organization and indices for the data set.

The need for a consistent organizational structure for all research topics and task designs [illegible] described in Appendix C. This appendix illustrates the process [illegible] research project implementation and is given as an example of the standards recommended for other research projects in the Impact Assessment of ALRT. The careful documentation of field data is of particular importance in light of the number of years to be covered by the study.

ALRT VISUAL IMPACT ASSESSMENT

Phase I: Visual Baseline Survey

Research Report

1.0 INTRODUCTION

2.0 METHODOLOGY

- 2.1 The Visual Assessment Study
- 2.2 Detailed Methodology For Phase I: Visual Baseline Survey

3.0 THE DATA SET

- 3.1 Photograph Numbers and Prefixes
- 3.2 Filing of Photographs
- 3.3 The Indices

APPENDICES:

Appendix E1: Visual Impact Assessment - A Review

1.0 INTRODUCTION

The need for an assessment of visual impacts was identified early in the development of the general design for the Impact Assessment of ALRT. The objective of the Visual Assessment Study was then defined:

- to document and evaluate the changes in the visual environment related to ALRT facilities.

The research questions specified in the research task design (Appendix D) were derived from this objective.

On the basis of the overall direction given in the research task design, a literature review, more specific objectives, a set of research questions and a methodology were prepared. A three-phase study was indicated:

- Phase I: Visual Baseline Survey
- Phase II: Visual Monitoring Survey
- Phase III: Visual Assessment Study

Construction of ALRT facilities, other than the demonstration section on Terminal Avenue and the Maintenance Yard, started in the fall of 1983 so the baseline survey had to be completed quickly in order to document the visual environment before the landscape changed significantly. This first data collection program was conducted in the fall and winter of 1983-84.

This report describes and marks the completion of the Visual Baseline Survey. Section 2.0, Methodology, describes the overall methodology for all three phases of the Visual Assessment Study and then details the methods actually used for the baseline survey. A summary of the literature review and the rationale for the design of the Visual Assessment Study is given in Appendix E1 of this report. Section 3.0 describes the photographic data set that is the product of the baseline survey. The color slides and negatives that make up the photographic data set are stored in separate volumes.

2.0 METHODOLOGY

2.1 The Visual Assessment Study

The objective of the Visual Assessment Study is to document and evaluate the changes in the visual environment related to ALRT facilities. On the basis of the overall direction given in the research task design (Appendix D) a three phase study was designed:

- Phase I Visual Baseline Survey
- Phase II Visual Monitoring Survey
- Phase III Visual Assessment Study

The documentation of the visual environment will be done photographically. The assessment of visual impacts will be based on comparisons between pairs of photographs showing conditions before and after ALRT.

This section of the report outlines the methods used in the baseline survey as well as the methods to be used in the monitoring survey and in the assessment. A detailed description of the methods actually used in the baseline survey is given in Section 2.2. A summary of the literature review and the rationale for the study methodology is given in Appendix E1.

o Phase I: Visual Baseline Study

This phase of the Visual Assessment Study was completed in the winter of 1983-84. The first stage, a review of the visual assessment literature, was guided by the research questions in the research task design:

1. To what extent has the visual character of the surrounding landscape been affected?
   Some of the areas that should be investigated are:
   - How well do ALRT facilities fit into the landscape in terms of line, form, texture, color and scale?
   - To what extent has the visual separation of adjacent areas been affected?
   - To what extent, and how effectively, have landscaping treatments such as linear parks been employed?

2. To what extent have viewing opportunities been affected?
   Some of the topics that should be investigated are:
   - To what extent have views from the surrounding areas been affected?
   - To what extent have new viewing opportunities been provided by ALRT?

3. To what extent has privacy been affected?
   One of the topics that should be investigated is:
   - Views into back yards and residences from elevated trains.

4. To what extent has solar access been affected?
   Some of the topics that should be investigated include:
   - Which areas are affected by shadows cast by ALRT facilities?
   - How do the shadow patterns vary throughout the year?

5. What are the most effective methods of documenting the visual environment?

6. What are the most effective methods for the assessment of visual impacts?

7. What is the spatial extent of the ALRT viewshed?

8. Which areas in the ALRT viewshed could be the most sensitive to changes in the visual environment due to ALRT?
   - This question should address possible visual/acoustical substitution/interaction effects.

Following the literature review a set of more specific research questions for the baseline survey was formulated:

1. What was the visual character of the viewshed prior to the start of construction?

2. To what extent has the visual character of the viewshed been affected?

3. To what extent, and how effectively, have landscaping treatments such as linear parks been employed?

4. To what extent have the views from the surrounding areas been affected?

5. To what extent have new viewing opportunities been provided?

6. To what extent has privacy been affected?

7. To what extent has solar access been affected?

8. How have people responded to the appearance of ALRT facilities?

The three phases of the study and their respective objectives were then defined. The objectives for the baseline survey were:

- to review the literature on visual assessment;
- to prepare a detailed design for the Visual Assessment study;
- to define the spatial extent of the ALRT viewshed;
- to document the visual characteristics of the viewshed prior to the start of construction; and
- to develop an indexing system that would facilitate the use of the data set.

The baseline survey was completed in the spring of 1984. Detailed descriptions of the methodology and results can be found in Sections 2.2 and 3.0 respectively.

- Phase II: Visual Monitoring Survey

The ALRT viewshed will be rephotographed following the completion of construction in 1986. The objectives for the Visual Monitoring Survey are:

. to review and refine the assessment phase in light of the visual characteristics of the viewshed after construction has been completed; and
. to document the visual characteristics of the viewshed after construction has been completed.

The review will determine whether some or all of the baseline views should be rephotographed. It will probably include refining the subdivision of the viewshed into visual landscape units and the identification of key views. The photo indices developed in Phase I will be used to ensure that monitoring and baseline photographs are taken from exactly the same locations.

- Phase III: Visual Assessment Study

The objective of the Visual Assesment Study will be:

. to identify and evaluate the visual impacts of ALRT.

The assessment will be based on comparisons between pairs of photographs showing conditions before and after ALRT. Assessments will be done by groups of experts and by groups of people from the Greater Vancouver area. The experts will be people experienced in visual assessment issues and techniques. The other groups will consist of people from outside the ALRT viewshed as well as from within. The comparisons will consist of rating sets of color slides as well as sorting color prints by preference. Zones of varying levels of impact will then be identified.

2.2 Detailed Methodology For Phase I: Visual Baseline Survey

Construction of ALRT facilities started in the fall of 1983 so the baseline survey had to be completed quickly in order to document the visual environment before it changed. This section of the report describes the methods used in the baseline survey.

On the basis of the specific research questions detailed in the overall methodology, the objectives of the Visual Baseline Survey were defined:

. to review the literature on visual assessment;
. to prepare a detailed design for the Visual Assessment Study;
. to define the spatial extent of the ALRT viewshed;
. to document the visual characteristics of the viewshed prior to the start of construction; and
. to develop an indexing system that would facilitate the use of the photographic data set.

In the fall of 1983 the ALRT corridor was analyzed and photographed to document the visual environment prior to the start of guideway construction. 1:25,000 and 1:10,000 scale black and white panchromatic aerial photographs were taken on September 21st. The boundaries of the area from which ALRT facilities will be visible (the viewshed) and the visual character of the various areas within it were determined through airphoto interpretation and extensive field studies.

Approximately 2000 ground-level photographs of the viewshed were taken using two 35 mm cameras, one loaded with color slide film and the other with color negative film. The locations from which the photographs were taken (the camera stations) were recorded on aerial photographs to ensure that the monitoring photographs (Phase II) can be taken from the same locations as the 1983 baseline photos. All photographs were numbered and filed in binders. A set of indices was prepared to ensure that all photographs taken in any one area of the viewshed could be identified.

The ALRT Viewshed

The ALRT viewshed is that area from which some part of the ALRT could be visible to a person standing at ground level. It also represents those areas that will be visible from the ALRT. Places from which the ALRT will not be visible are therefore outside the viewshed. In mapping the viewshed the screening effects of existing buildings and vegetation were considered. In places where the seasonal loss of leaves by deciduous trees could result in a larger viewshed, the larger one was mapped.

The viewshed (Figure 1) was first delineated by driving all streets and lanes adjacent to the proposed alignment of the ALRT and marking the boundaries on maps and air photos. The boundaries were refined during the photography phase since all areas within the ALRT corridor were explored on foot.

Aerial Photography

On September 21, 1983, before the start of construction, 1:10,000 and 1:25,000 scale vertical aerial photographs of the ALRT corridor were obtained. Figure 2 shows the areas covered by the 1:25,000 scale photography while Figure 3 shows the 1:10,000 coverage. Some of the 1:10,000 air photos were enlarged to 1:5,000 scale and used as base maps. The base maps and air photos were essential for identifying and documenting camera stations during the ground photography phase.

Ground Level Photography

All the ground-level photographs of the ALRT viewshed are 35 mm color slides and color negatives taken at approximately the same time using a pair of Nikon FE cameras with 28 mm wide-angle lenses. The rationale for the selection of photographic techniques is given in Appendix E1. The factors considered in obtaining the photographs were:

- Visual Sensitivity;
- Distance Zones;
- Camera Stations;
- Views;
- Photography; and
- Documentation.

Each of these factors is described in greater detail below.

- Visual Sensitivity

The relative visual sensitivity of various areas within the viewshed guided the selection of camera stations with the density of photographic sampling being highest in the most visually sensitive areas.

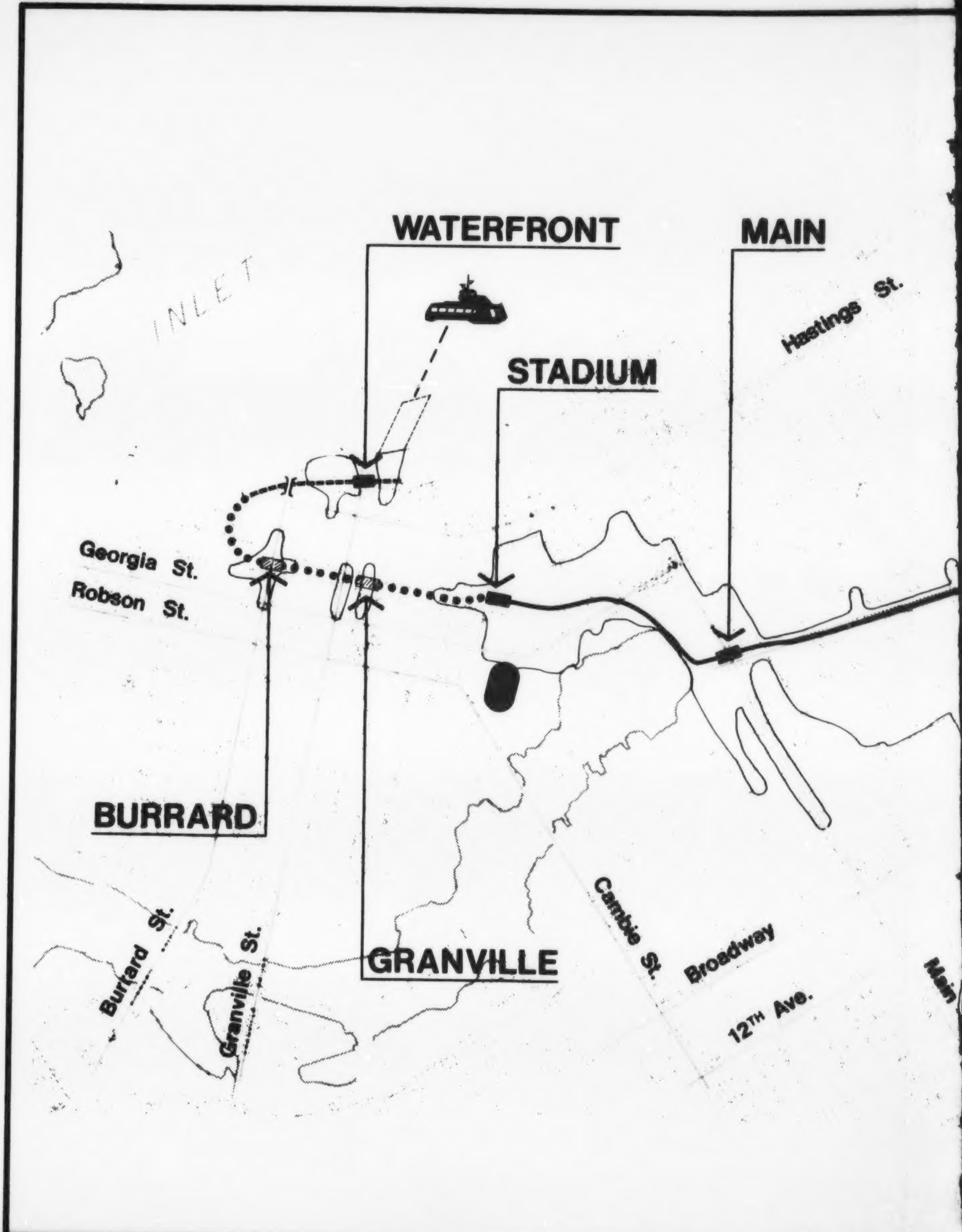
A series of map overlays (Table 1) were developed and then combined to identify areas of greatest sensitivity.

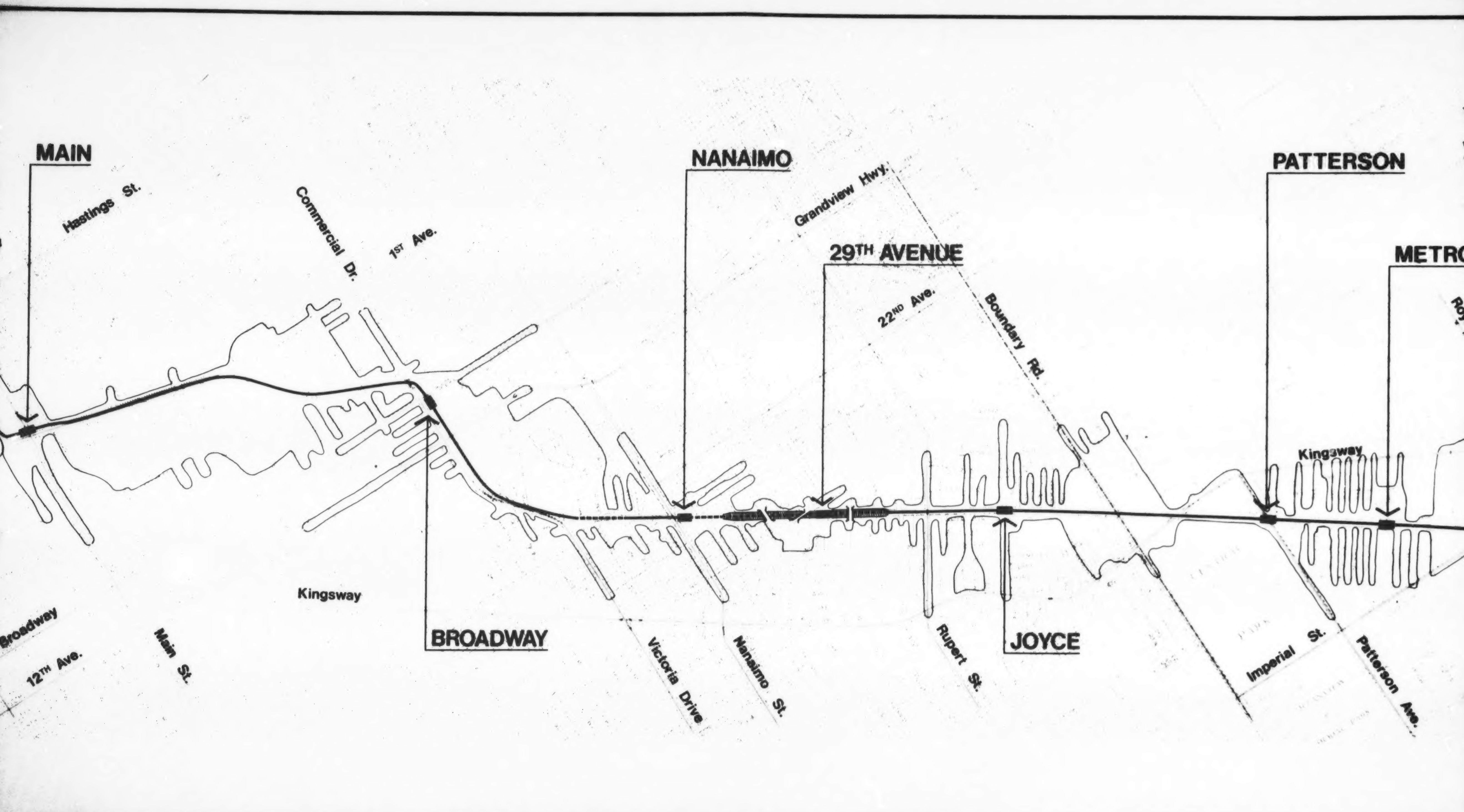
SENSITIVITY OVERLAY	LEAST SENSITIVE CATEGORY	MOST SENSITIVE CATEGORY
1. Distance from ALRT	Viewer more than 200 m away	Viewer less than 30 m away
2. Land Use	Commercial Industrial Woodland	Single family residential
3. Viewer Position	Viewer downslope	Viewer upslope
4. ALRT Position	ALRT in cut	ALRT elevated
5. Orientation of Major View	Away from ALRT	Towards ALRT
6. View Type	Close-up views of commercial or industrial areas	Unobstructed long distance views
7. Scale Difference	ALRT smaller than surrounding landscape elements	ALRT much larger than surrounding landscape elements

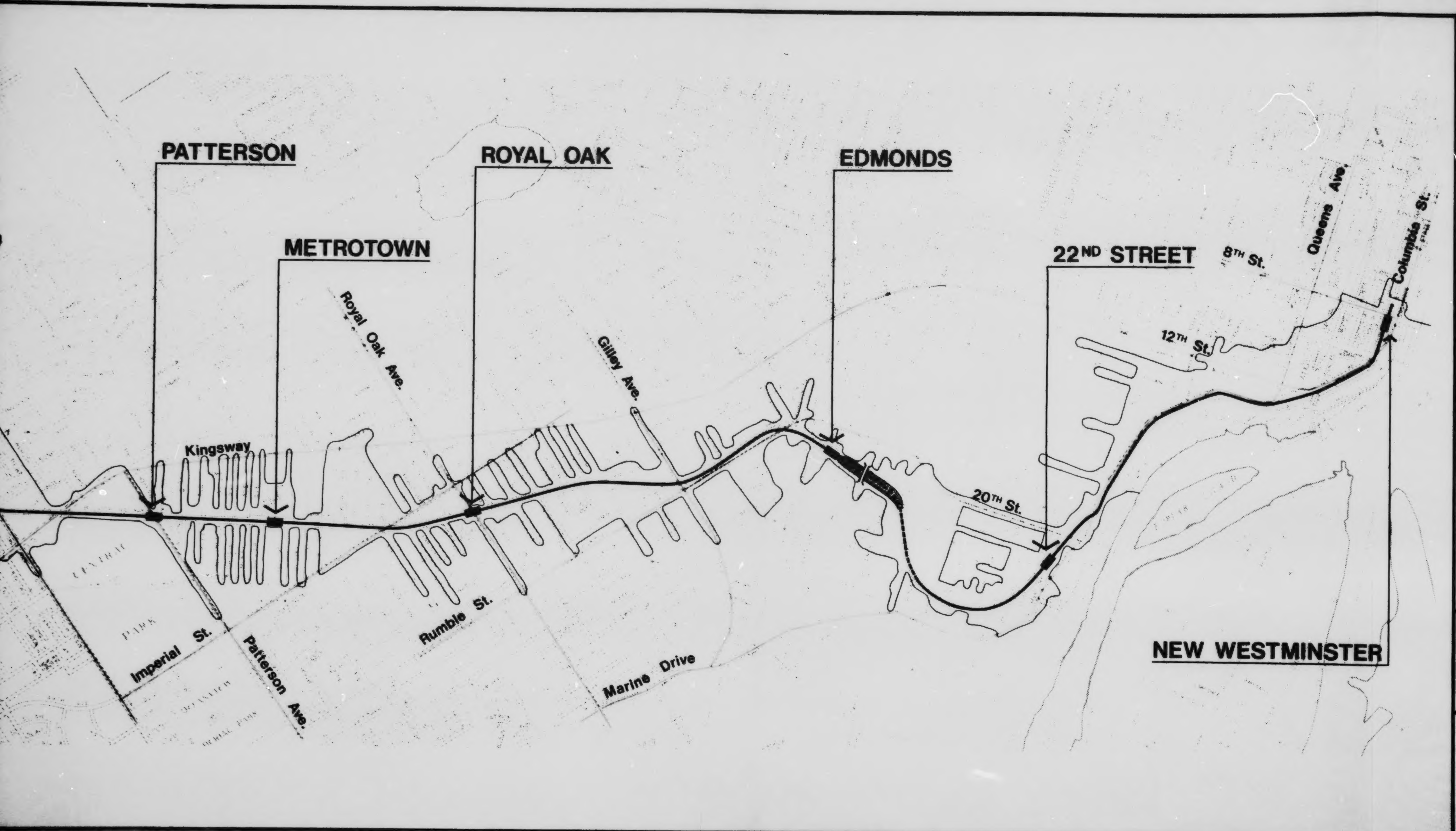
Table 1: Map Overlays Used to Estimate Relative Visual Sensitivity

- Distance Zones

Photographic studies revealed that the existing Main Street Station appeared very large in the visual field when seen from less than 30 m


WATERFRONT
MAIN
INLET
Hastings St.
STADIUM
Georgia St.
Robson St.
BURRARD
Cambie St.
Burrard St.
Granville St.
GRANVILLE
Broadway
Main
12TH Ave.
Burrard
Granville


MAIN
Hastings St.
Commercial Dr.
1ST Ave.
NANAIMO
Grandview Hwy.
29TH AVENUE
22ND Ave.
Boundary Rd.
PATTERSON
METR
Kingsway
Broadway
12TH Ave.
Main St.
Kingsway
BROADWAY
Victoria Drive
Nanaimo St.
Rupert St.
JOYCE
Imperial St.
Patterson Ave.


PATTERSON
ROYAL OAK
EDMONDS
METROTOWN
22ND STREET
8TH St.
Queens Ave.
Columbia St.
Royal Oak Ave.
Gilley Ave.
12TH St.
Kingsway
20TH St.
CENTRAL PARK
Imperial St.
Patterson Ave.
Rumble St.
Marine Drive
NEW WESTMINSTER

IM
A
O

VI
AS

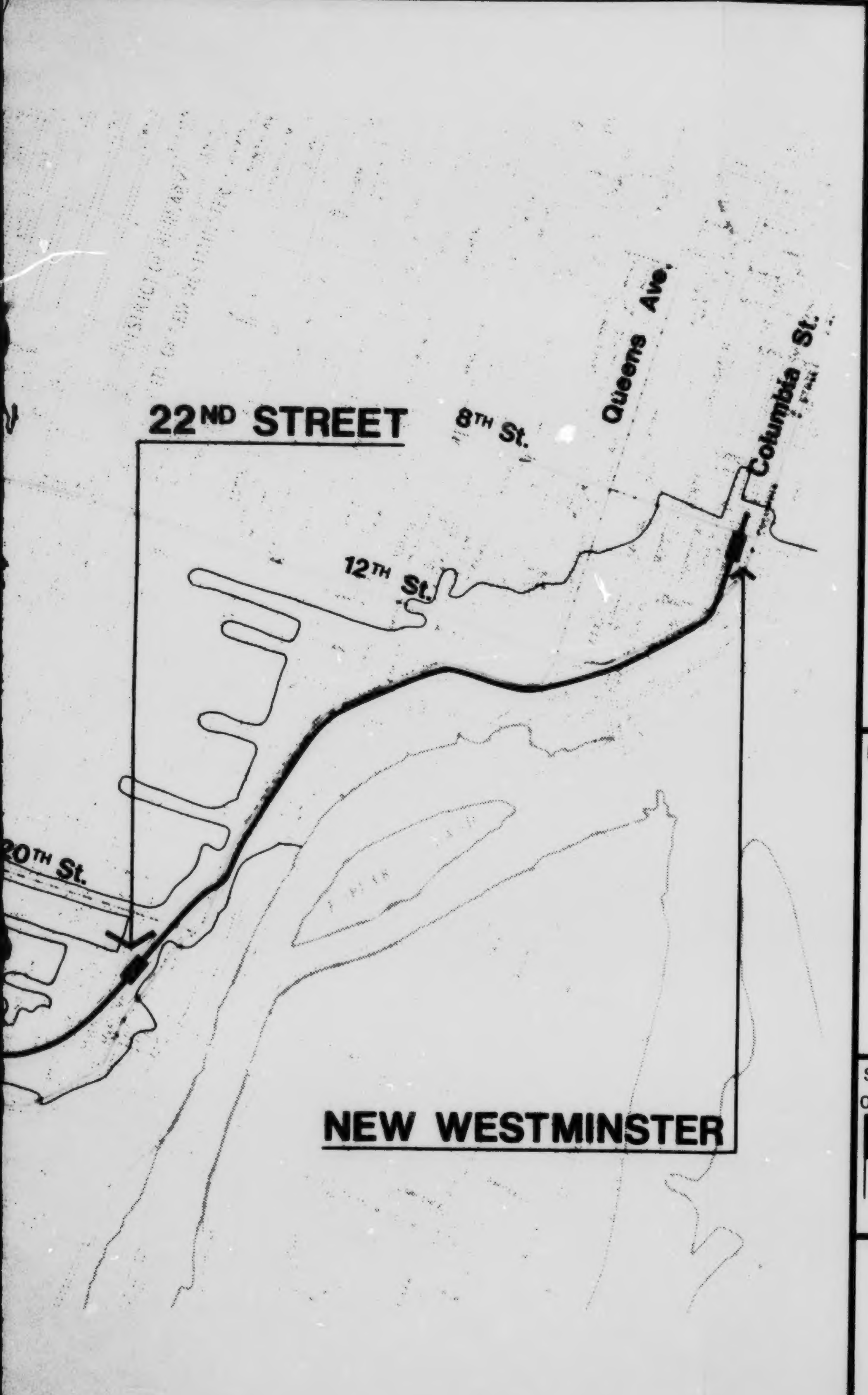
Pha
Vis

Legend

Scale
0 20

T

MacL


22ND STREET
8TH St.
Queens Ave.
Columbia St.
12TH St.
20TH St.
NEW WESTMINSTER

IMPACT ASSESSMENT OF ALRT

VISUAL ASSESSMENT

Phase I:
Visual Baseline Survey

Legend

Elevated	━━━
At Grade	╍╍╍
In Cut	▨
Underground	● ● ● ●
Station	━■━
Underground Station	━▥━
Major Street	
ALRT Viewshed	⊂⊃

Scale
0 200 400 600 800 1000
M

NORTH

THE ALRT VIEWSHED

MacLAREN PLANSEARCH Lavalin

Figure 1

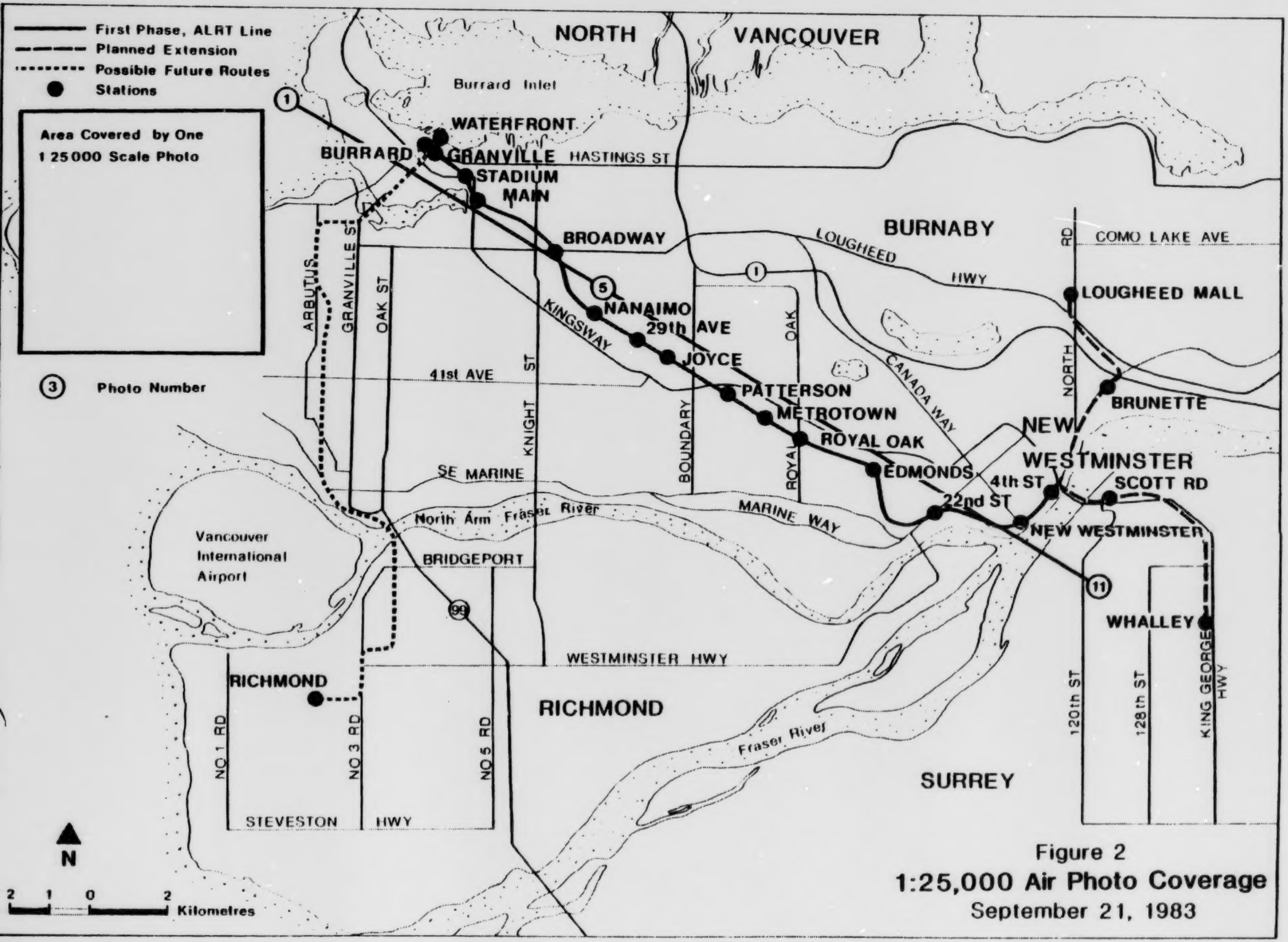

First Phase, ALRT Line
Planned Extension
Possible Future Routes
Stations
Area Covered by One 1 25 000 Scale Photo
③ Photo Number
NORTH
VANCOUVER
Burrard Inlet
WATERFRONT
BURRARD
GRANVILLE
HASTINGS ST
STADIUM
MAIN
BROADWAY
BURNABY
LOUGHEED HWY
COMO LAKE AVE
NORTH RD
LOUGHEED MALL
①
⑤
NANAIMO
29th AVE
JOYCE
PATTERSON
METROTOWN
ROYAL OAK
EDMONDS
22nd ST
4th ST
NEW WESTMINSTER
SCOTT RD
BRUNETTE
NEW WESTMINSTER
WHALLEY
⑪
KINGSWAY
CANADA WAY
41st AVE
SE MARINE
MARINE WAY
ARBUTUS
GRANVILLE ST
OAK ST
KNIGHT ST
BOUNDARY
ROYAL OAK
North Arm Fraser River
Vancouver International Airport
BRIDGEPORT
99
WESTMINSTER HWY
RICHMOND
RICHMOND
NO 1 RD
NO 3 RD
NO 5 RD
STEVESTON HWY
Fraser River
SURREY
120th ST
128th ST
KING GEORGE HWY
N
2 1 0 2 Kilometres

Figure 2

1:25,000 Air Photo Coverage

September 21, 1983

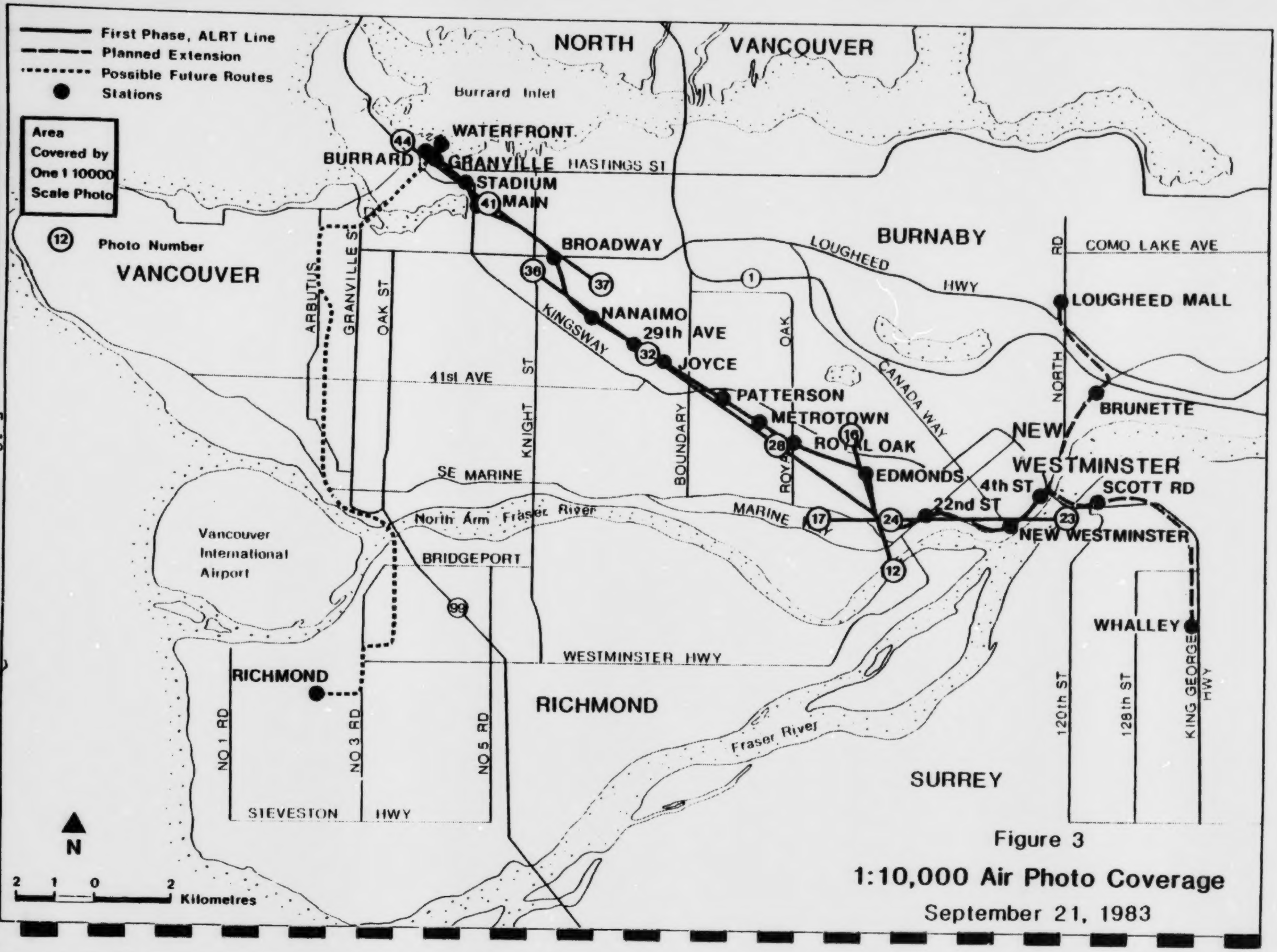

First Phase, ALRT Line
Planned Extension
Possible Future Routes
Stations
Area Covered by One 1 10000 Scale Photo
12 Photo Number
NORTH
VANCOUVER
Burrard Inlet
WATERFRONT
BURRARD
GRANVILLE
HASTINGS ST
STADIUM
MAIN
BROADWAY
NANAIMO
29th AVE
JOYCE
PATTERSON
METROTOWN
ROYAL OAK
EDMONDS
22nd ST
4th ST
NEW WESTMINSTER
SCOTT RD
WHALLEY
LOUGHEED MALL
BRUNETTE
BURNABY
LOUGHEED HWY
COMO LAKE AVE
NORTH RD
CANADA WAY
KINGSWAY
VANCOUVER
ARBUTUS
GRANVILLE ST
OAK ST
41st AVE
KNIGHT ST
BOUNDARY
OAK
ROYAL
SE MARINE
MARINE WAY
North Arm Fraser River
BRIDGEPORT
Vancouver International Airport
WESTMINSTER HWY
RICHMOND
NO 1 RD
NO 3 RD
NO 5 RD
STEVESTON HWY
Fraser River
SURREY
120th ST
128th ST
KING GEORGE HWY
44
41
36
37
32
28
16
17
24
23
12
1
99
N
2 1 0 2 Kilometres

Figure 3

1:10,000 Air Photo Coverage

September 21, 1983

away while from beyond 200 m it appeared very small. Sites further than 500 m from the guideway were considered to be outside the viewshed since ALRT facilities generally blended into the landscape at these distances. Table 2 describes the three distance zones, the apparent size of ALRT facilities and the relative visual sensitivity classes that were defined.

Distance Zone	Apparent Size of ALRT Facilities	Relative Visual Sensitivity Class
200 - 500 m	Very small	1. Least
30 - 200 m		2. Moderate
< 30 m	Very large	3. Most

Table 2: Distance Zones and Relative Visual Sensitivity Classes in the ALRT Viewshed

- Camera Stations

All the neighborhoods within the viewshed were explored on foot and the camera stations selected using the following criteria:

- they should be representative pedestrian views from public places where people would normally go, such as roads, sidewalks, lanes and parks;
- the distribution of camera stations should reflect the priorities established in the visual sensitivity analysis; and
- each neighborhood should be photographed so there would be enough photographs to permit selection of representative photo pairs when ALRT is operational.

- Views

Once at the camera station, the view or views were selected using the following criteria:

- views should show what the pedestrian would normally see, such as views down the sidewalks, or
- views should show what a motorist would see if:
  - the motorist's view would be substantially different from that of the pedestrian (due to street trees, telephone poles, or signs); or
  - few pedestrians could be expected in the area (eg. along Rumble Street near Gilley Avenue); or
  - the area offers few opportunities for pedestrian movement (eg. lack of sidewalks).
- multiple views should be used where the ALRT could be visible in several directions;
- major view orientation should be selected on the basis of viewer movement and natural focal points; and

- to be representative of the areas and not give a better impression than what the situation really is, the photographs should not be "composed" to remove signs, poles and other visual clutter.

Photography

Once the views were selected the photographs were taken using the following procedure:

- views were framed at pedestrian eye level;
- a clinometer was used to locate a distant point level with the center of view;
- the automatic exposure reading was used unless there was strong contrast in the composition, in which case a manual meter reading of the foreground was used;
- the cameras were held level and sighted on the level point (due to lack of time a tripod was not used);
- the numbers of moving cars and pedestrians in the foreground were minimized by waiting for them to pass; and
- exactly the same view was used for both cameras.

Documentation

Careful documentation of camera station locations and numbers is essential to ensure that the 1986 monitoring shots can be taken from the same locations as the baseline photographs. Immediately after each photograph was taken, the camera station was circled and numbered on the appropriate air photo and labelled with roll and frame numbers.

The beginning and end of each day of photography was also noted on a separate tally sheet along with notes on the general area being photographed, the time of day, weather, and lighting conditions.

The photographs have all been numbered and filed in binders and a set of index photos, index tables and contact sheets covering the complete photographic data set has been prepared. The structure of the data set is described in the next section.

3.0 THE DATA SET

In the baseline survey approximately 2200 color photographs of the ALRT corridor prior to the start of guideway construction were obtained and then assembled into a photographic data set. These baseline photographs are views of the ALRT corridor from various camera stations that were selected to provide thorough coverage of the variety of views from each of the many landscape types in the viewshed. At each camera station at least one view was identified and in many cases 3 or even 4 were selected. Two photographs were taken of each view, one a color slide and the other a color negative. Each camera station was marked with a circle and a number on a photo-map. The numbering and filing of the photographs and the various indices set up to facilitate their retrieval are described in greater detail below.

3.1 Numbers and Prefixes

Each view was assigned a unique number consisting of the roll and frame number of the photograph. Since the color slide and the color negative for any one view were identical they were assigned the same number. The prefixes used to differentiate between photographs taken at different stages of the project are described in Table 3.

Prefix	Category	Description
M	Miscellaneous	- photos taken during the design and callibration of the data set
-	Baseline	- no prefix - photos of baseline conditions in 1983 and 1984
a	Construction	- photographs obtained at various times during the construction phase
b	Monitoring	- photographs of the operational ALRT - to be taken as part of Phase II in 1986 and later

Table 3 Photograph Prefixes For The Data Set

3.2 Filing

The various components of the data set are filed in a series of separate appendices (Table 4) that are held by the study manager.

Appendix	Title	Form
B	Indices for the Visual Assessment Data Set	8 1/2 x 11 binder
C	Slides 1	8 1/2 x 11 binder
D	Slides 2	8 1/2 x 11 binder
E	Slides 3	8 1/2 x 11 binder
F	Negatives	8 1/2 x 11 binder
G	Miscellaneous and Construction Photos	8 1/2 x 11 binder
H	Miscellaneous and Baseline Prints	4 x 6 filedrawer

Table 4 Components of the Visual Assessment Data Set

The appendices that are referred to below and in Table 4 are part of the data set and are not appended to the study design report.

The index book (Appendix B) contains three sets of indices including 13 index maps that illustrate all photographs taken in each of the 13 sections of the viewshed (the index book is described in more detail in the next section of this report).

The baseline color slides are stored in plastic sleeves in three separate volumes (Appendices C, D and E). They are arranged geographically by index map and filed in the numerical sequence shown on each map. Once the monitoring photography has been done the baseline - monitoring photo-pairs should be filed in adjacent slots to facilitate comparisons.

The color negatives are filed chronologically by roll and frame number as Appendix F. Numbered contact sheets of all negatives are filed in the index book to facilitate retrieval.

Miscellaneous and construction photographs are filed as Appendix G. A partial set of baseline prints is stored in a 4 x 6 file drawer (Appendix H).

3.3 The Indices

An index book, containing a users guide to the data set (Table 5) and three sets of indices, has been prepared to facilitate the identification and retrieval of photographs of the ALRT viewshed from the data set.

The best way of retrieving photographs will depend on what the needs are. Since there are many ways of accessing the data set, the easiest ways of meeting the most common data needs are shown in Table 5, Users Guide to the Visual Assessment Data Set.

The three sets of indices in the index book are:

- Index Maps;
- Chronological Index Tables; and
- Contact Sheets.

The 13 Index Maps show all photographs taken within each of the 13 sections of the viewshed (Figures 4 and 5). The other two sets of indices, the chronological index tables and the photographic contact sheets, list photographs in the order in which they were taken. The characteristics of each set are summarized in Table 6. A complete set of indices appears in the index book that accompanies the data set.

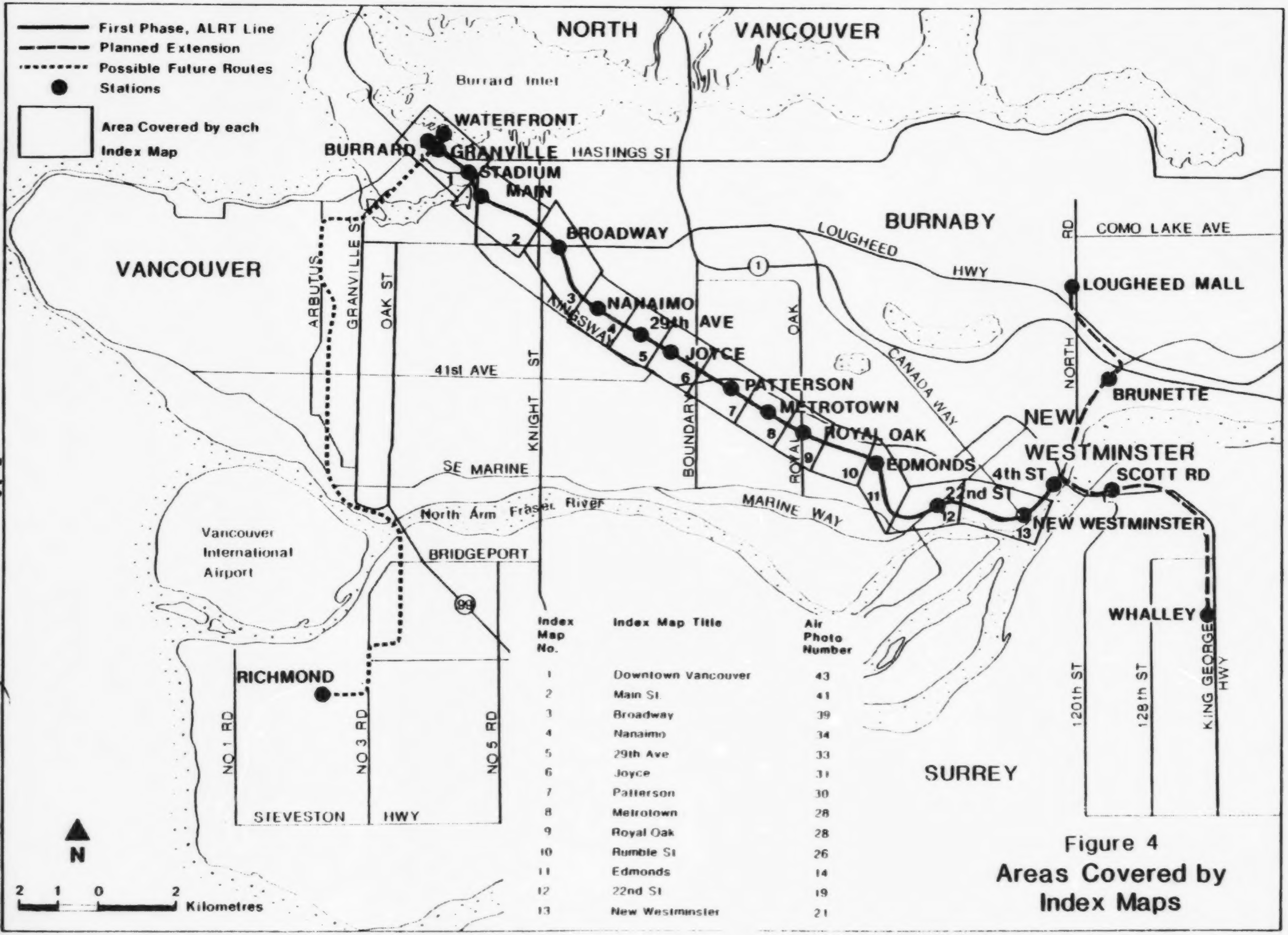
A fourth index that should be set up to facilitate defining landscape units and selecting views for monitoring photography would consist of a set of 3 x 5 color prints of all views.

Data Needs	Easiest Data Access Methods
• View all the photographs of a particular neighborhood.	1) Use the "Areas Covered" map (Figure B1 in the Index Book) to determine which index map covers the area of interest.
	2) Go to the relevant index map and determine the roll and frame numbers of photographs in the area of interest.
	3) View the slides (Appendices C, D and E) since they are all numbered and filed by index map area.
• A quick overview of all photographs in the data set.	1) Flip through the contact sheets in the Index Book since they show all photographs in chronological order.
• The geographic location of a photograph with a particular roll and frame number.	1) Refer to the chronological index tables in the Index Book.
• Details such as date and time of day for a photograph.	1) Refer to the chronological index tables.

Table 5 Users Guide to the Visual Assessment Data Set

Index Category	Description
Index Maps	. 13 photomaps that cover the complete ALRT line from downtown Vancouver to downtown New Westminster; . each map shows all photographs taken within the indicated section of the viewshed; . they are 1:5,000 scale enlargements of the 1:10,000 scale air photos that were flown in the fall of 1983; and . they were selected to give the best coverage of the viewshed and named for the station areas covered (see Figure 4).
Chronological Index Tables	. list all photographs in the order in which they were taken; and . give detail such as date, time and index map area; . will be useful when trying to match time of year and time of day for the monitoring photos.
Contact Sheets	. miniature photographic prints of each color negative in each roll of film in the data set; and . show all photographs in chronological order without regard for location.

Table 6 Indices For The Visual Assessment Data Set


First Phase, ALRT Line
Planned Extension
Possible Future Routes
Stations
Area Covered by each Index Map
NORTH
VANCOUVER
Burrard Inlet
WATERFRONT
BURRARD
GRANVILLE
HASTINGS ST
STADIUM
MAIN
BROADWAY
NANAIMO
29th AVE
JOYCE
PATTERSON
METROTOWN
ROYAL OAK
EDMONDS
22nd ST
4th ST
NEW WESTMINSTER
SCOTT RD
WHALLEY
LOUGHEED MALL
BRUNETTE
NEW WESTMINSTER
BURNABY
VANCOUVER
SURREY
RICHMOND
COMO LAKE AVE
NORTH RD
LOUGHEED HWY
CANADA WAY
KINGSWAY
41st AVE
SE MARINE
MARINE WAY
ARBUTUS
GRANVILLE ST
OAK ST
KNIGHT ST
BOUNDARY
OAK
ROYAL
North Arm Fraser River
Vancouver International Airport
BRIDGEPORT
NO 1 RD
NO 3 RD
NO 5 RD
STEVESTON HWY
120th ST
128th ST
KING GEORGE HWY
1
99
1
2
3
4
5
6
7
8
9
10
11
12
13
N
2 1 0 2 Kilometres

Index Map No.	Index Map Title	Air Photo Number
1	Downtown Vancouver	43
2	Main St.	41
3	Broadway	39
4	Nanaimo	34
5	29th Ave	33
6	Joyce	31
7	Patterson	30
8	Metrotown	28
9	Royal Oak	28
10	Rumble St	26
11	Edmonds	14
12	22nd St	19
13	New Westminster	21

Figure 4
Areas Covered by Index Maps

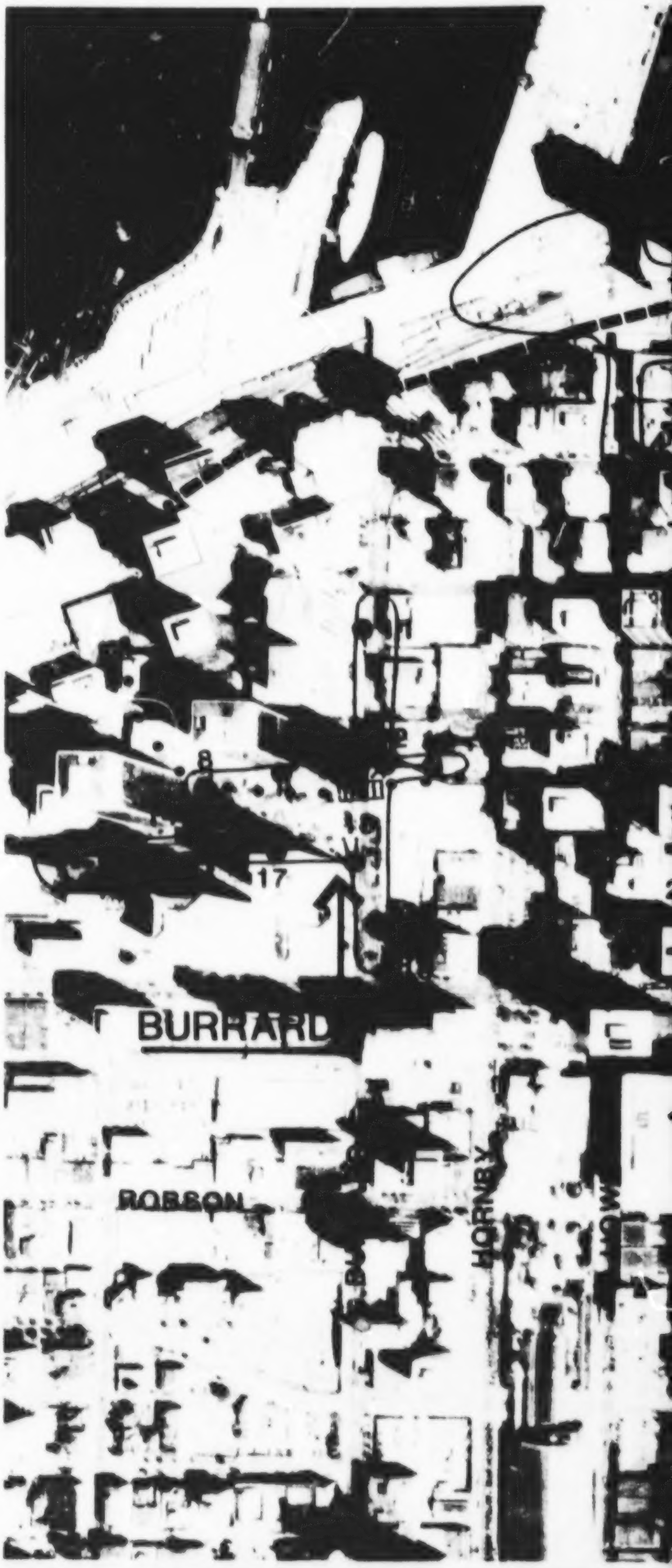
PHOTO INDEX #1: DOWNTOWN VANCOUVER

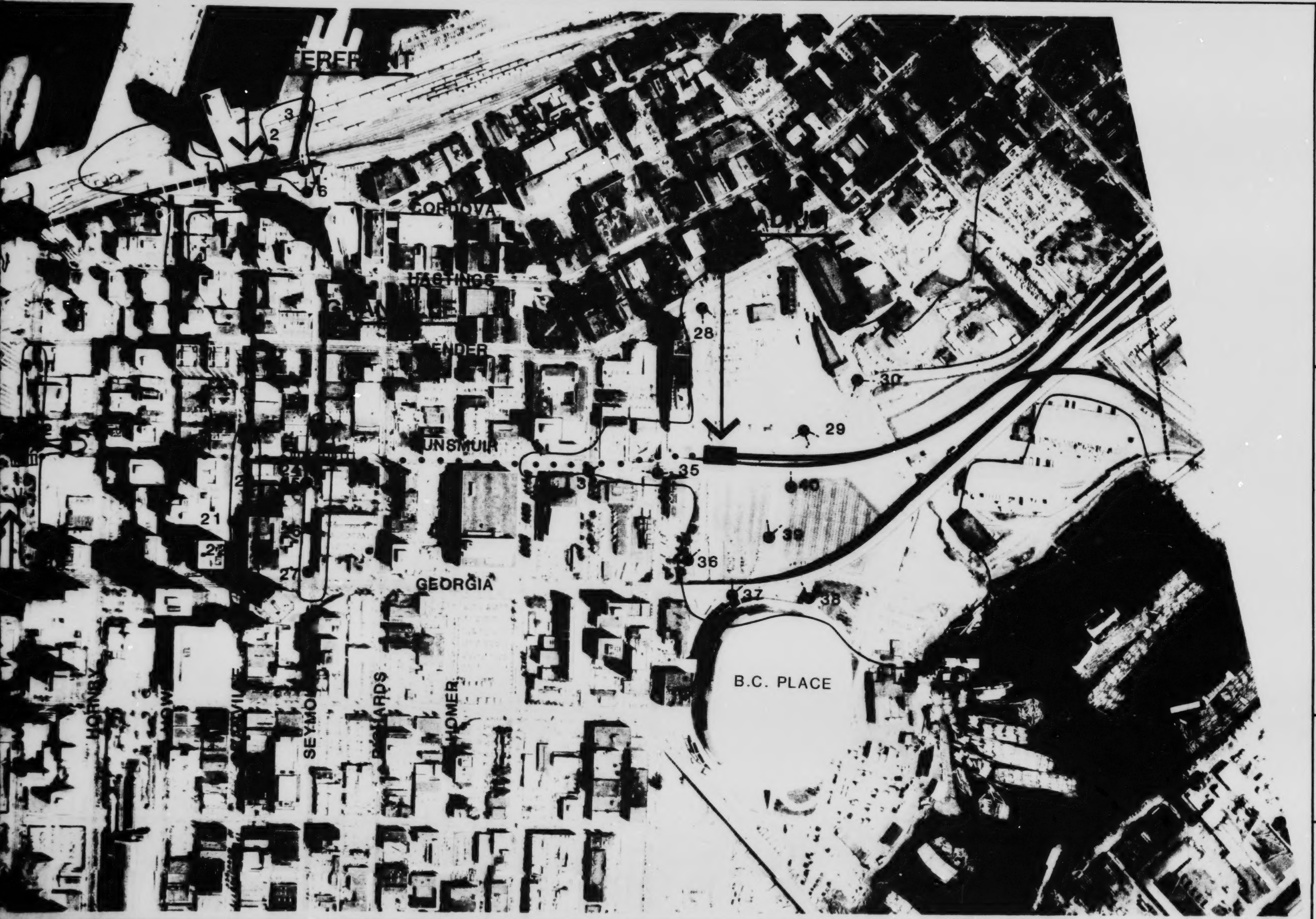
Cam Stn	Photo Number Baseline	Photo Number Monit
1	34.25	
	.26	
2	34.24	
3	34.18	
	.19	
	.20	
	.21	
4	34.28	
5	34.27	
6	34.23	
7	34.22	
8	34.02	
	.03	
9	33.33	
	.34	
	.35	
10	33.31	
	.32	
11	33.30	
12	33.28	
	.29	
13	33.27	
14	34.04	
	.05	
15	34.06	
16	34.07	
17	34.08	
	.09	
	.10	
18	34.11	
	.12	
	.13	
19	34.14	
20	34.29	
	.30	
21	34.32	
22	34.33	
23	34.31	
24	35.02	
25	34.36	
26	34.35	
27	34.34	
28	35.21	
	.22	
29	35.15	
	.16	
	.17	

Cam Stn	Photo Number Baseline	Photo Number Monit
30	35.18	
	.19	
	.20	
31	35.23	
32	35.24	
	.25	
33	35.26	
34	35.06	
35	35.03	
	.04	
	.05	
36	35.07	
37	35.08	
	.09	
38	35.10	
	.11	
39	35.12	
	.13	
40	35.14	

KEY

Cam Stn	Photo Number Baseline	Photo Number Monit
1	34.25	
	.26	
↑	↑	▲
Camera Station	Roll and Frame No's of the two baseline Photographs taken from this camera station	Monitoring photographs that will be taken from this camera station in 1986




WATERFRONT
CORDOVA
HASTINGS
GRANVILLE
PENDER
DUNSMUIR
GEORGIA
HORNBY
HOWE
GRANVILLE
SEYMOUR
RICHARDS
HOMER
B.C. PLACE
1
2
3
6
21
22
24
25
26
27
28
29
30
31
33
35
36
37
38
39
40

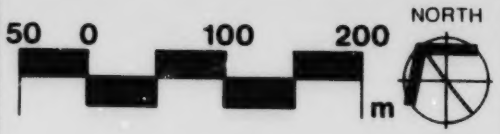
IMPACT ASSESSMENT OF ALRT

VISUAL ASSESSMENT

Phase I:
Visual Baseline Survey

Legend

Elevated ━━━
At Grade ▬ ▬ ▬
In Cut ▨
Underground • • • • •
Station ━■━
Underground Station • •▥• •
ALRT Viewshed ⊃
Camera Station ●2


50
0
100
200
m
NORTH

INDEX MAPS

1. DOWNTOWN VANCOUVER

Figure 5

APPENDIX E1 Visual Impact Assessment: A Review

E1.1 Visual Impact Assessment

The visual qualities of the landscape are of such economic importance today that the value of landscape aesthetics has been quantified and marketed. There is a lively real estate market in "view property" and the tax assessors take note of increased property values due to "panoramic sound-and-mountain views" and even "peek-a-boo views" (Blair 1980). The identification and evaluation of desireable views is a critical component in real estate assessments.

Although the visual environment has been a source of inspiration for writers, painters, musicians and scientists for many years, attitudes towards the landscape have changed over time. Landscape painting, with its explicit focus on the physical landscape, is the dominant pictorial art form in the contemporary Western world. However, in Western cultures, the idea of using the landscape as a subject for painting did not appear until the Renaissance when the attitude towards man's place in nature changed and nature became a positive part of the world view. Although the beginnings of landscape art can be found at least as far back as the fourteenth century, the notion of painting nature as anything other than a backdrop is a relatively recent phenomenon (Clark, 1949).

Tuan's description (1974) of varying responses to mountainous landscapes expressed by different cultures illustrates the the fact that attitudes towards the landscape vary with culture as well as with time:

- the Hebrews beheld mountains with confidence;
- the early Greeks experienced awe as well as aversion before an aspect of nature they could not wholly grasp;
- the Romans described them as aloof, hostile and desolate; while
- the Taoists enveloped them in a aura of mystery and built their temples there.

Users of visual assessment methods must ensure that their studies recognize the variety of attitudes that people hold towards their environment and that these attitudes change over time.

Visual issues have been dealt with in a variety of ways using methods that range from the purely idiosyncratic and personal to highly elaborate statistical analyses. In their detailed descriptions of the landscape, writers like Thoreau made little attempt to develop systematic measures with which to evaluate and compare landscape values and, until the late 1960's, visual assessments tended to be intuitive solutions to project-design scale problems. Only recently have the visual aspects of regional land management issues been addressed by formal analysis and the use of explicit, repeatable processes. Even today, many people claim that the assessment of landscape aesthetics lies in the realm of personal taste ("beauty is in the eye of the beholder") and that a systematic approach to visual assessment is not possible. However, numerous studies in Britain and the United States have found that there can be significant agreement among a wide variety of people on what constitutes high visual quality. As Cerny observed in his 1974 review of scenic analysis and assessment, "scenic analysis is a relatively new area of research, though an old area of interest" (p.244).

Land managers, landscape architects, environmental planners, geographers and psychologists have begun to develop criteria for the systematic assessment of the visual qualities of the landscape.

E1.2 Visual Resource Management

Numerous visual assessments have been conducted in Great Britain, Australia, the United States and Canada in the past few years although most of them have dealt with rural or undeveloped areas. There are several descriptions of the characteristics of urban landscapes (Appleyard, 1976 and 1981; Lynch 1960) but only a few investigators (Hopkinson 1971, 1972; Blair 1980 and Brown and Park, 1982) have tried to deal with the visual implications of development in urban areas. The following descriptions of visual resource management have been adapted from Brown and Park (1982), Arnot and Grant (1981) and Blair (1980).

Among the visual assessment studies in Great Britain are several quantitative analyses of the visual intrusion of highways in both urban and rural areas. Compton and Gilbert (1970) derived a numerical measure of visual intrusion for traffic that Hopkinson (1971, 1972) refined into a visual intrusion index based on solid angle subtense, a measure of the apparent size of an object in the visual field. He then conducted satisfaction-disatisfaction surveys of large samples of respondents and found that the public assessment of views could be predicted, even though it is complex and dependent on many variables.

Arnot and Grant (1981) describe the PUCE method, developed in Australia by the Commonwealth Scientific and Industrial Research Organization (CSIRO). They state that it is important to search for objective standards in landscape appreciation and that geomorphology and landforms have intrinsic value in determining the quality of landscape. The PUCE method is a relatively objective method of terrain analysis used to classify undeveloped landscapes on the basis of natural characteristics such as topography, slope, lithology, soil and vegetation. Criteria for the evaluation of landscape aesthetics are then introduced - the assessment being done in the field by a group of experts experienced in terrain classification and land use planning.

In the United States, Visual Resource Management (VRM) is a specialized area of planning and design that has been developed over the past decade. It is a systematic, two phase approach that uses an assessment of visual resources as an input into planning and design decisions. VRM addresses regional land management issues and facility siting options as well as project design. It can be an important logical link between planning and detailed project design and can go far to ensure that developers anticipate, and respond to, public concerns about the visual effects of projects.

The "Visual Management System" of the Forest Service and the "Visual Resource Management System" of the Bureau of Land Management were the first such systematic approaches to visual resource management. Both methods operate within the context of rural and wildland settings where a single agency controls project development and manages the adjoining lands (Blair, 1980, pp 6,7). Two other Federal agencies that have operational VRM systems are the Soil Conservation Service (SCS) and the Federal Highway Administration (FHWA). The SCS "Landscape Architecture System" is intended to integrate aesthetic considerations into project planning and design. In contrast, the FHWA, which does not generally plan highway projects but funds and reviews them, provides technical assistance to state highway agencies with its training course manual "Esthetics and Visual Resource Management for Highways".

A number of other agencies, including the Corps of Engineers and HUD, are still considering ways in which to incorporate visual resources into their programs.

These four operational VRM systems span the range of applications from large-scale planning to project review. Although their terminology differs, all four identify similar elements of the visual experience and use similar overall approaches to visual assessment. The elements and overall approach of the VRM method are the basis for the ALRT Visual Assessment Study.

Several visual assessment studies have recently been conducted in various parts of British Columbia:

- Visual Impact Assessment for the Proposed CP Rail Second Mainline Through the Selkirk Mountains, 1983 (prepared by MacLaren Plansearch for CP Rail);
- A Visual Sensitivity Analysis of the Municipality of Spallumcheen, 1976 (initiated by the B.C. Land Commission);
- A Resource Analysis of the Adams River, 1978 (prepared for the B.C. Parks Branch);
- Visual Resources of the Northeast Coal Study Area; B.C Ministry of Environment; RAB Bulletin 5; 1977 (prepared by R.J. Tetlow and S.R.J. Sheppard) and;
- A Visual Assessment of the Northeast Coal Extension Area.

The Ministry of the Environment has also been responsible for visual studies in the Gulf Islands, Kootenay Lake, the Slocan Valley and the East Kootenay/Winderemere/Invermere Area. Several of these studies are outlined by W.C. Yeomans in his forthcoming book "Visual Resource Assessment in British Columbia: A User Guide".

Visual Resource Management (VRM) is a systematic approach to the assessment and management of visual resources. Visual impact assessments are studies whose primary objective is to determine whether a proposed development will result in significant changes in the character of the area in which it will be built or in the views from adjacent areas.

The various elements usually considered in the VRM approach to the evaluation of visual impacts are illustrated in Table i.

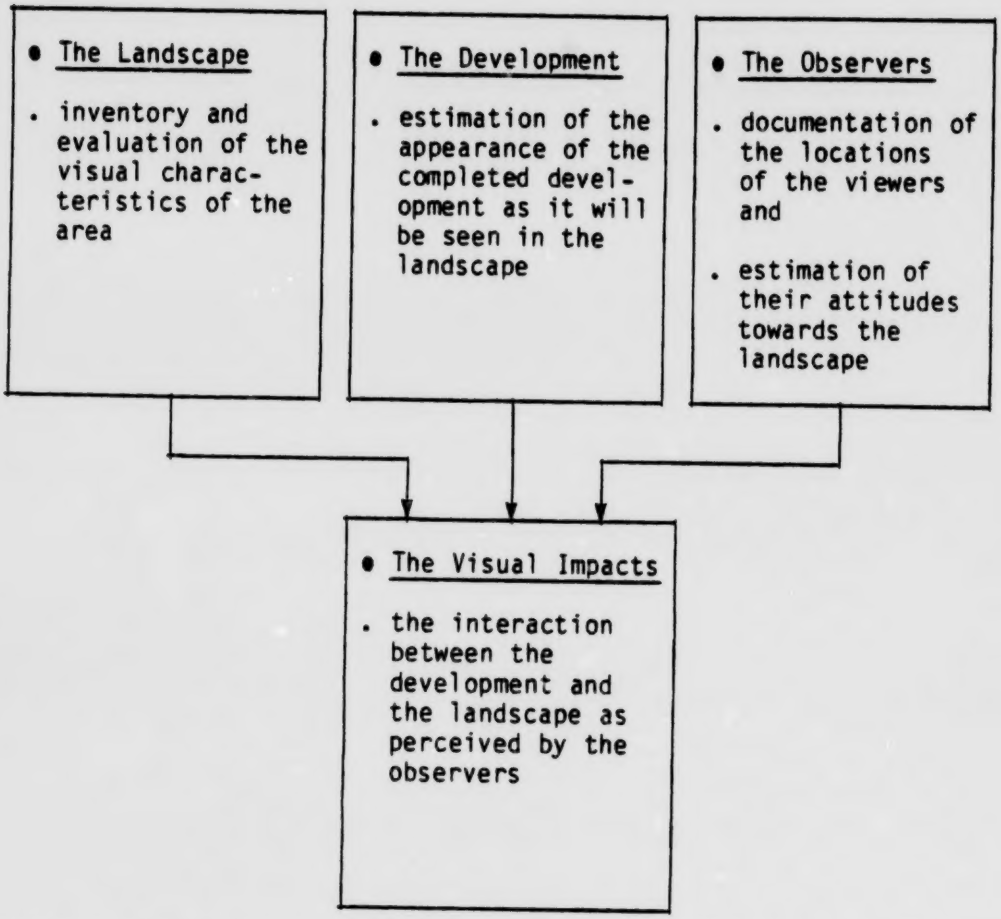

• The Landscape
. inventory and evaluation of the visual characteristics of the area
• The Development
. estimation of the appearance of the completed development as it will be seen in the landscape
• The Observers
. documentation of the locations of the viewers and
. estimation of their attitudes towards the landscape
• The Visual Impacts
. the interaction between the development and the landscape as perceived by the observers

Table i: Elements Usually Considered in the VRM Approach to the Evaluation of Visual Impacts

- The Landscape

The evaluation of the visual characteristics of an area is an assessment of the scenic quality of the landscape. This assessment can be done by a professional designer, a group of experts, or by groups of people from various backgrounds. It usually results in a rating scheme in which the scenic quality of the landscape is described in comparison with other landscapes.

- The Development

The estimate of the appearance of the completed development is based on design details and is usually performed by professional designers.

- The Observers

The people who will be in the area will view the landscape from the development as well as seeing the development from the landscape. They will be observing from a variety of locations and will respond to what they see on the basis of their attitudes, values and beliefs. The evaluation of the observers usually considers:

- views of the development as well as views from it;
- the locations from which the observers will see the landscape, e.g. from an adjacent lane, from down the street or from an elevated transit vehicle (The fact that double-decker tour buses are beginning to appear on the streets of Vancouver is an illustration of the value of elevated views in the visual appreciation of the landscape.);
- the numbers of observers at each of the viewpoints;
- the effects of dynamic elements like the speed of travel, the seasons and the weather on what is seen and
- the attitudes that the observers have towards what they see.

- The Visual Impacts

The perceived visual impacts of a development are the result of the interaction between the development and the landscape as perceived by the observers. Some of the elements that are included in the assessment of visual impacts are:

- the visibility of the development from the viewpoints as determined by the ability of foreground elements such as buildings and vegetation to screen it from view;
- the magnitude of contrast between the development and the landscape in terms of line, colour, texture and form and
- the attitudes of the observers towards what they are able to see.

In evaluating the visual impacts of linear transportation facilities like highways and railroads, views of the development as well as views from it must be considered since an improvement to one often leads to degradation of the other. For example; siting a highway alongside a park to give travellers good views of the landscape could detract from the visual character of the park and could also adversely affect views of people living in adjacent areas.

E1.3 Visual Assessment Techniques

Conventional 35 mm color photographs were selected as the best way to document the ALRT visual environment and provide a means of evaluating visual impacts. The rationale for this selection is presented below.

The key element in visual assessment, the evaluation of the visual environment, is normally based on the subjective responses of groups of observers. Due to the logistical difficulties and expense of transporting people to various areas to evaluate views, numerous methods of bringing the views to the people have been developed. These simulations can be in the form of drawings, paintings and still photographs as well as video and cinematographic films.

Perspective views such as photographs, drawings and paintings provide the most realistic simulations of the landscape and of these, photographs are the most frequently used.

Huddart (1976) found that the reality of transportation systems in rural landscapes could be successfully simulated using both colour cinematographic films and colour still photographs. The cine films were somewhat more effective, especially when moving traffic was a significant part of the view, but they were more difficult and more expensive to obtain than still photographs. Slee (1979) found that both cine and video techniques could be used to simulate proposed development. Although motion pictures can provide more realistic simulations they are not often used because of relatively high cost and the specialized expertise required.

When assessing still photographs, Huddart (1976) found that large colour prints provided a successful simulation and were somewhat better than black and white prints. Griggs and Huddart (1978) state that "the total visual impact of a road may be adequately assessed in many situations using still photographs" (p. 7). Several studies in the United States have shown that visual responses to landscape photographs are consistent with visual responses to the actual landscapes (Shafer and Richards, 1974; Zube et al., 1974) although the magnitude of the responses is generally lower. In other words, peoples' preference for certain landscapes will be reflected in their responses to photographs of those landscapes but their reactions to the photographs will be less dramatic than their responses to the real thing. Many recent visual assessment studies (eg. Cerny, 1974; Coughlin and Goldstein, 1970) have made use of color slides and color prints.

The selection of colour slides or colour prints depends in part on the use to which they will be put. Colour prints have been found to be the most effective medium for presentations to individuals or very small groups and good quality black and white reproductions for use in reports can be made from colour negatives. On the other hand, colour slides are of more practical value when presentations are being made to larger groups of people. To cover the most probable range of uses for the photographs of the ALRT corridor, both colour slides and colour negatives were obtained.

The 35 mm format was chosen for several reasons:

- it is relatively easy to obtain good quality photographs;
- the BC Transit audio/visual system uses 35 mm format;
- most of the slide projection systems used in professional offices are 35 mm format; and
- it is in widespread use and equipment is available at local camera rental stores.

The field of view is the diagonal width of an image and it determines how much of the real world is captured in a painting or photograph. In photography, the selection of the focal length of the camera lens will determine the field of view. However, the eyes normally encompass a particular field of view and the selection of unusual camera lenses like the fish-eyes or telephotos can produce photographs that are quite different from what we normally see.

Studies of human vision have shown that although the full field of view for two normal eyes is about 180°, there is a marked decrease in perception away from the center of view. As a result, things at the periphery are seen "out of the corner of the eye" and are therefore much less visible.

Many of the paintings and drawings that most of us see encompass a field of view that is about 40°, the same as that for the lens most commonly employed in photography, the "standard" lens. In fact, Hopkinson (1971) suggests that this lens became the standard because when cameras were first being developed, the designers responded to what seemed to be the normal view in the visual arts. Unlike photographers, visual artists were not constrained by optics so the evolution of a "standard" field of view must have had its origin in an understanding of human response to the visual environment.

A wide angle lens captures a wider field of view than a standard lens while a telephoto encompasses a much narrower field. Some investigators (Pitt and Zube, 1979) state that regular, wide-angle or panoramic photographs may all be used as simulations in visual assessment studies while others (Blair, pers. comm.) hold that the focal length has to be carefully controlled to ensure that the photographs accurately illustrate what would be seen at the site. Most of the visual assessment studies in the literature seem to be based on photographs taken with a "standard" lens which, in the 35 mm format, has a focal length of 50 to 55 mm.

However, much of the ALRT viewshed is within 30 meters of the edge of the guideway. Studies of the existing Main Street Station revealed that a photograph taken 30 metres from the edge of the guideway with a standard lens would not include all of the guideway and the train, much less the station. Experimentation with a variety of lenses revealed that the 28 mm focal length was the best compromise between the need to encompass a wide visual field and the concern about presenting photographs not significantly different from those that people are accustomed to seeing.

To document the visual character of the ALRT viewshed, 35 mm colour slides and colour negatives were taken using a pair of Nikon FE cameras with 28 mm wide angle lenses.

E1.4 References

Appleyard, D., M.S. Gerson and M. Lintell 1981. Liveable Streets; Berkeley and Los Angeles: University of California Press.

Appleyard, D., M.S. Gerson and M. Lintell 1976. Liveable Urban Streets: Managing Auto Traffic in Neighbourhoods, Washington, D.C.: Superintendent of Documents; U.S. Gov't Printing Office. (Prepared for Federal Highway Administration, Department of Transportation).

Arnot R.H. and K. Grant 1981. "The Application of a Method for Terrain Analysis to Functional Land-Capability Assessment and Aesthetic Landscape Appreciation", Landscape Planning; 8 (1981) 269-300.

Blair, William G.E. 1980. "Visual Resource Management". Environmental Comment; Washington, D.C.: The Urban Land Institute; June 1980, 6-15.

Brown, G.R. and D.F. Park 1982. "Visual Intrusion Impact of Residential Traffic". Transportation Engineering Journal of ASCE; Vol. 108, No. TE5, September 1982; pp. 468-483.

Cerny, James W. 1974. "Scenic Analysis and Assessment". CRC Critical Reviews in Environmental Control. V. 4, No. 2, June 1974; pp. 221-250.

Clark, Kenneth 1949. Landscape Into Art; New York: Harper and Row Inc.

Compton, D.H., D. Gilbert et al. 1978. Environmental Capacity and Traffic Management: Case Study of a District of London, London: Imperial College.

Grigg, A.O. and L. Huddart 1978. "Three Surveys of the Visual Intrusion of Roads in Rural Landscapes"; TRRL Laboratory Report 861; Berkshire: Transportation and Road Research Laboratory.

Hopkinson, R. and N. Watson 1971. Visual Intrusion Studies: Report on Work Completed May to October 1971; a report prepared for the Department of the Environment; London: Environmental Design Consultants.

Hopkinson, R. and N. Watson 1972. Visual Intrusion Studies: Studies in Quantitative Assessment in Relation to Urban Motorways; London: Environmental Design Consultants; 70 pp.

Hopkinson, R. and Watson, N. 1974. The Visual Effects of Roads and Traffic; London; a report to the secretary of State, Dept. of Environment.

Huddart, Linda 1976. "Visual Intrusion of Roads and Traffic: A Case Study in the Lake District"; TRRL Supplementary Report 186 UC; Berkshire: Transport and Road Research Laboratory; 25 pp.

Lynch, Kevin 1960. The Image of the City; Cambridge, Massachusetts: The MIT Press.

McAllister, Donald M. 1980. Evaluation in Environmental Planning; Cambridge, Massachusetts: The MIT Press.

Murray, Burce H. and Bernard J. Niemann Jr. 1979. "Visual Quality Testimony in an Adversary Setting" in Proceedings of Our National Landscape: a Conference on Applied Techniques for Analysis and Management of the Visual Resouce; USDA, Forest Service, General Technical Report PSW-35; Washington, D.C.: US Government Printing Office.

Nicholson, Marjorie Hope 1959. Mountain Gloom and Mountain Glory; The Development of the Esthetics of the Infinite: Ithaca, N.Y.: Cornell University Press.

Pitt, David G. and Ervin H. Zube 1979. "The Q-Sort Method: Use in Landscape Assessment Research and Landscape Planning" in Proceedings of Our National Landscape: a Conference on Applied Techniques for Analysis and Management of the Visual Resource; USDA, Forest Service General Technical Report PSW-35; Washington, D.C.: US Government Printing Office; pp. 227-234.

Slee, B.J. 1979. "Simulating the Appearance of Rural Roads", TRRL Supplementary Report 426; Berkshire: Transportation and Road Research Laboratory; 15 pp.

Steinitz, C.F. and Frederick 1974. Perception: A summary of the Literature: Harvard Graduate School of Design: unpublished paper.

Tetlow, R.J. and S.R.J. Sheppard 1977. "Visual Resources of the Northeast Coal Study Area", RAB Bulletin 5, Victoria: B.C. Ministry of Environment.

Transport and Road Research Laboratory 1980. "Roads and the Environment: A Collection of Papers Prepared at TRRL"; Supplementary Report 356; Crowthorne, Berkshire: Transportation and Road Research Laboratory.

Tuan, Yi-Fu 1974. Topophilia: A Study of Environmental Perception, Attitudes and Values; Englewood Cliffs, N.J.: Prentice-Hall Inc.

U.S. Department of the Interior 1980. Visual Simulation Techniques; Washington, D.C.: US Government Printing Office.

Yeomans, W.C. 1982. Visual Resource Assessment in British Columbia: A User Guide, unpublished Draft Report, Victoria: B.C. Ministry of Environment.

BIBLIOGRAPHY

Authors

Altman, I. and J.F. Wohlwill (Ed.), Human Behaviour and Environment; Advances In Theory and Research, Volume 2, Plenum Press, 1977.

Anderson, A.C., "The Effect of Rapid Transit On Property Values," The Appraisal Journal, January 1970, 59-67.

Andrews, J.A.C., (Ed.), Transportation Systems For the City of Vancouver: An Appraisal, Vancouver, N.D. Lea and Associates Ltd. (Prepared for the City of Vancouver), November 1986.

Apcar, M., Report on ALRT Recommendations For System Performance Assurrance, Vancouver, (Prepared for B.C. Transit), March 1981.

Appleton, J., The Experience Of Landscape, London, John Wiley and Sons, 1975.

Appleyard, D., M.S. Gerson and M. Lintell, Liveable Streets, Los Angeles, University of California Press, 1981.

Appleyard, D., M.S. Gerson and M. Lintell, Liveable Urban Streets: Managing Auto Traffic In Neighbourhoods, Washington, D.C., U.S. Gov't Printing Office, (Prepared for U.S. Dept. of Transportation, FHWA), 1976.

Arnot, R.H. and K. Grant, "The Application Of A Method For Terrain Analysis: To Functional Land-Capability Assessment and Aesthetic Landscape Appreciation," Landscape Planning, VIII, 1, 269-300.

Atkinson, W.G., Alternatives To Fixed Route Transit, Vancouver, Manop Services Ltd., (Paper presented at Transit '81 conference (UTA), UBC), 1981.

Baehr, G., "A New Lease On Life For Nework Subway," Mass Transit, IX No. 10, 1982.

Barcham, D. and H. Goldman, Value Capture by Transit Service Levy, Vancouver, MacLaren Plansearch, Lavalin Inc., (Prepared for Min. of Municipal Affairs, B.C.), 1982.

Bardwell, G.E. and P.R. Merry, "Measuring the Economic Impact of the Limited Access Highway on Communities, Land Use and Land Value," Highway Research Board Bulletin, 268, 1960, 37-73.

Becker, A.J. and W.K. Talley, "Alternative Methodologies for Measuring Transit Benefits," Transportation Research Record, 735, (National Academy of Sciences, abridgement), 1981.

Bee, C.K. and M.A. Sargious, A More Comprehensive Evaluation of Urban Transportation Impacts, Calgary, (Presented at Transit '81 conference (UBC) held by B.C. Transit), 1981.

Bell, P.A., J.D. Fisher and R.J. Loomis, Environmental Psychology, Philadelphia, W.B. Saunders Company, 1976.

Bendixon, T., Instead of Cars, London, Temple Smith, 1974.

Bensal, P., D. Quasun and P.J. Hills (ed.), Urban Transportation Planning: Current Theses and Future Prospects, Abacus Press, 1977.

Billheimer, J.W. and R.R. Trexler, Evaluation Handbook for Transportation Impact Assessment, Los Altos, California, Systan Inc., (Prepared for the U.S. Dept. of Transportation, UMTA), December 1980.

Blair, W.G.E., "Visual Resource Management," Environmental Comment, Washington, D.C., The Urban Land Use Institute, June 1980, 6-15.

Blayney, J., D. Dornbusch and M. Dyett, Study Design and Project Implementation Plan - Phase II, San Francisco, John Blayney Associates and David M. Dornbusch and Company, BART Impact Program, (Prepared for U.S. Dept. of Transportation and Dept. of Housing and Urban Development), March 1977.

Boorse, J.W., Rapid Transit In Canada, Philadelphia, Almo Press, 1968.

Bourne, L.W., "Market Location and Site Selection In Apartment Construction," Canadian Geographer, VII-4, 1968, 211-226.

Bourne, L.S. and M.J. Doucet, Dimensions Of Metropolitan Physical Growth: Land Use Change, Metropolitan Toronto, Prepared by Centre for Urban and Community Studies, Research Report 38, Toronto, U. of Toronto, 1970.

Bowes, R.W. "Improving Urban Transit", Traffic Quarterly, Westport, Conn., ENO Foundation For Transportation Inc., April 1978.

Brand, D., B. Barber and M. Jacobs, "Technique for Relating Transportation Improvements and Urban Development Patterns", Highway Research Report 207, 1967, 43-64.

Brown, G.R., "A Policy Model For Multimodal Transportation System Planning," Transportation Research Series: Report No. 2, Vancouver, Dept. of Civil Engineering, UBC, 1973.

Brown, G.R., Transportation Noise: Environmental Impact and Assessment, Unpublished Paper, Vancouver, U.B.C., no date.

Brown, G.R. and C. Fish, "The LOGIT Model: A Critical Analysis," Transportation Research Series: Report No. 6, Vancouver, Dept. of Civil Engineering, UBC, 1975.

Brown, G.R. and C. Fish, "A Note On The Entropy Formulation of Commodity Distribution Models," Transportation Research Series: Report No. 5, Vancouver, Dept. of Civil Engineering, UBC, 1975.

Brown, G. and D.F. Park, "Visual Intrusion Impact Of Residential Traffic," *Transportation Engineering*, American Society of Civil Engineering,September 1982, 468-483.

Brown, G. and W. Sauer, "Socio-Economic and Situational Factors In Urban Traffic Noise Annoyance Level," Stringer, P. and H. Wenzel (Ed.), *Transportation Planning For A Better Environment*, New York, Plenum Press, 1976.

Bryfogle, R.C. and R.R. Krueger, *Urban Problems*, Toronto, Holt Rinehart and Winston of Canada Ltd., 1975.

Buckley, D.J. (Ed.), *Transportation and Traffic Theory*, (Proceedings of the Sixth International Symposium On Transportation and Traffic Theory), U. of South Wales, Australia, 1974.

Byrne, R.M., D.E. Priest and J.T. Black, et al., *Joint Development: Making the Real Estate - Transit Connection*, Urban Land Institute and Gladstone Associates, Washington, (Prepared for U.S. Dept. of Transportation, UMTA), 1979.

Campitelli, G., W. Zonnenberg et. al., *Scarborough Town Center Light Rail Transit Feasibility Study*, Metro Toronto, Prepared by the Metropolitan Toronto Planning Dept. and the Toronto Transit Commission, April 1977.

Canter, L.W., *Environmental Impact Assessment*, New York, McGraw-Hill Book Co., 1977.

Carey, W.N. Jr., et al., *Impact Of the Bay Area Rapid Transit System on the San Francisco Metropolitan Region*, Washington, (Special Report 111) Highway Research Board (Proceedings of a conference workshop 2/9/70), 1970.

Carroll, D.J., "Fitting Transportation Systems Plans to Urban Land-Use Projections," *The Dynamics Of Urban Transportation*, (Prepared for the National Symposium sponsored by the Automobile Manufacturers Association Inc.), 1962.

Cerny, J.W., "Scenic Analysis and Assessment," *CRC Critical Reviews In Environmental Control*, IV No. 2, June 1974, 221-250.

Cherian, V., *Transit Monitoring Program: Documentation of Programs and Data Files*, Victoria, B.C., Capital Regional District, 1982.

Cherian, V. and D.W. Langley, *"Capital Regional District Regional Transportation Model: An Outline*, Victoria, Capital Regional District, 1982.

Cherian, V. and M.A. Sargious, "A Multinomial LOGIT Approach for Multimodal Choice of Work Trips", *Canadian Journal of Civil Engineering*, IV(1), Calgary, 1977.

Child, G., The Influence of Limited Access Highways On Land Use and Land Value in Lexington, Virginia, (Prepared for the Virginia Council of Highway Investigation and Research), 1958.

Chumak, A. and D. Bolger, Investigating the Impact of LRT On Travel Behaviour In Calgary, Calgary, Transportation Department, 1983.

Coates, J.F., "Some Methods and Techniques for Comprehensive Impact Assessment," Technology Forecasting, VI-4, 1, 341-357.

Cohn, L.F., "Evolution of Environmental Analysis at the State Transportation Level," Transportation Research Record, No. 789, 1981.

Cohn, L.F., G.R. McVoy, Environmental Analysis of Transportation Systems, John Wiley and Sons, 1982.

Coleny, D.C., Study of the Effect, If Any, Of An Urban Freeway Upon Properties Contiguous to the Right of Way, Research Foundation, University of Toledo, 1966.

Compton, D.H., D. Gilbert et. al., Environmental Capacity and Traffic Management: Case Study of a District of London, London, Imperial College, 1978.

Conway, T., "Rapid Transit Must Be Improved To Alleviate Congestion," Traffic Quarterly, March 1968, 103-118.

Cribbins, P.D., W.T. Hill and H.O. Seagraves, "Economic Impact Of Selected Sections of Interstate Route On Land Value and Use," Highway Research Record 75, 1965, 1-31.

Curtis, F.A., "Work Trip Demand Modelling For Small Communities: Experience In Kingston Township, Ontario," Plan Canada, XXI No. 4, 1982.

Dare, C.E., Cedar Rapids I-380: Freeway Noise, Multiple Land Use and Aesthetics Study, Cedar Rapids, 1973.

Davis, F.W., "Proximity to Rapid Transit Stations As A Factor In Residential Property Values," The Appraisal Journal, October 1970, 554-572.

Dewees, D.N., The Impact of Urban Transportation Investment On Land Value, Toronto, Prepared by a joint program in Transportation: U. of Toronto and York University, 1973.

Dickey, J.W., Metropolitan Transportation Planning, Washington, Scripta Books Co., McGraw-Hill, 1975.

Dickey, J.W., Metropolitan Transportation Planning, 2nd Ed., Washington, D.C., Hemisphere Publishing Corp., McGraw-Hill, 1983.

Dienemann, P.F. and A.M. Lago, "Environmental and Social Costs Impacts of Northeast Corridor Transportation System Technologies," Transportation System Technologies, June 1970.

Domencich, T.A. and D. McFadden, *Urban Travel Demand*, Amsterdam, North-Holland Publishing Co., 1975.

Donnea, F.X. De., *The Determinants of Transport Mode Choice In Dutch Cities*, Rotterdam, Rotterdam University Press, 1971.

Donnelly, P., *Rail Transit Impact Studies: Atlanta, Washington, San Diego, Summary Report*, Washington D.C. (Prepared for U.S. Dept. of Transportation, UMTA), 1982.

Donnelly, R., J. Arguelles, *Implications of Bay Area Rapid Transit's (BART's) Impacts For the Transportation Disadvantaged*, San Francisco, Metropolitan Transportation Commission and Urban Dynamics Associates, (Prepared for U.S. Dept. of Transportation and Dept. of Housing and Urban Development), April 1979.

Dooley, J.E., *Identification and Measurement Of Transportation Impacts*, Toronto, Prepared by "Joint Program In Transportation: U. of Toronto and York University, 1977.

Drolet, R.E., "Evaluation of Urban Public Transit System Performance International Perspectives," *RTAC Forum*, Ottawa, V.5 No. 2, 1982.

Dvett, M., D. Dornbusch, M. Fajans and C. Falcke, *Land Use and Urban Development Impacts of Bay Area Rapid Transit (BART)*, San Francisco, Metropolitan Transportation Commission with Blayney (John) Associates and Dornbusch (David M.) and Co., Inc. (Prepared for U.S. Dept. of Transportation and Dept. of Housing and Urban Development), April 1979.

Enzer, S., "Cross-Impact Techniques In Technology Assessment," *Futures*, IV No. 1, 1972, 30-51.

Evans, R.J. (Ed.), *Decisions '81: Responding To Contradictory Pressures*, Oakville, Oakville Transit, 1981.

Falcke, C.O., *Methodologies For Assessing The Impacts of Major Transportation Facilities On Land Use and Land Prices*, David M. Dornbusch and Company, Inc., San Francisco, (Prepared for U.S. Dept. of Transportation, Transportation Systems Center - Cambridge, M.A.), 1982.

Fan, H. and A. Sherret, *Explanatory Modeling of Transbay Travel Choice*, San Francisco, Peat Marwick Mitchel and Co., (Prepared for Dept. of Transportation, Wash, D.C.), November 1977.

Fortin, G., *Cost Sharing for Inter-Municipal Transit*, Ottawa, Transport Canada, (TP 1832), 1979.

Gamble and Savinroy, "Beneficial Effects Associated With Freeway Construction, Environmental, Social and Economic," *Transportation Research Board, Report 193*, (Prepared as part of the National Cooperative Highway Research Program (U.S.), no date.

Garrison, W.L., *Influence of Highway Improvements On Urban land: A Graphic Summary*, 1958.

Gerecke, K. An Evaluation of Canadian Urban Planning: Occasional Paper No. 10, Waterloo, Faculty of Environmental Studies, University of Waterloo, 1973.

Gilbert, K. and F.A. Wagner, Transportation System Management: An Assessment of Impacts, Washington D.C., (Prepared for the U.S. Dept. of Transportation, UMTA), 1978.

Goldberg, M.A., "Transportation, Urban Land Values and Rent: A Synthesis," Land Economics, XLIX No. 2, May 1970, 153-162.

Goldberg, M.A. and T.D. Heaver, "A Cost Benefit Evaluation Of Transportation Corridors," Highway Research Record 305, 1970, 28-40.

Goldman, H. (Ed.), Vancouver Transit System Energy Efficiency Evaluation, MacLaren Plansearch Corp. (Lavalin Inc.), 1981.

Graebner, L.S., P.B. Giles et al., The Impact of BART On Public Policy, San Francisco, Booz, Allen & Hamilton Inc., (Prepared for U.S. Department of Transportation & Dept. of Housing and Urban Development, Washington, D.C.), April 1979.

Graebner, L.S., P.B. Giles and T.J. Higgins, Local Policy Implications of Bay Area Rapid Transit (BART) Development, Prepared by Metropolitan Transportation Commission and Booz-Allen and Hamilton Inc., (Prepared for U.S. Dept. of Transportation and Dept. of Housing and Urban Development), April 1979.

Graff, D.L., and R.L. Knight, Environmental Impacts of Bay Area Rapid Transit (BART), Prepared by Metropolitan Transportation Commission, Gruen Associates, Inc. and Deleuw, Cather and Co., (Prepared for the U.S. Department of Transportation and Dept. of Housing and Urban Development), April 1979.

Grefe, R. and A.N. McDonald, Economic and Financial Impacts Of Bay Area Rapid Transit, Metropolitan Transportation Commission and McDonald and Grefe Inc., San Francisco, (Prepared by U.S. Dept. of Transportation and Dept. of Housing and Urban Development, Wash. D.C.), April 1979.

Grigg, A.D. and L. Huddart, "Three Surveys of the Visual Intrusion of Roads In Rural Landscapes," TRRL Laboratory Report 861, Berkshire, G.B., Transportation and Road Research Laboratory, 1978.

Hackney, D.C., "Prepare To Ride Into The Future On New LRT Cars," Mass Transit, (Focus on Philadelphia and Cleveland), VIII No. 6, 1981.

Hall, J. and S. Maynes, 1976 Transit Survey, Vancouver, Engineering Dept. City of Vancouver, September 1977.

Hanna, H.M., A.M. Khan and L.A. Shallal, "Simulation of A Binary Choice LOGIT Model for the Ottawa-Hull Area," RTAC Forum, III, No. 2, 1981.

Hansen, J. and R. Stussi, Noise and the Urban Environment, (An occasional student paper), Center For Transportation Studies, University of British Columbia, 1971.

Harris, R.A., "Determination of Effectiveness of Noise Barriers Along I-285, Atlanta," Transportation Research Record, No. 865, 1980.

Harmelink, M.D., Noise and Vibration Control for Transportation Systems, Toronto, (Prepared for City of Downsview), 1970.

Hartwick, P.G., An Analysis of an Urban Thoroughfare, Ottawa, (Working Paper No. A-71-3), Canadian Ministry of State for Urban Affairs, 1971.

Heathington, K.W., F.W. Davis et al. Research Needs for Evaluating Urban Public Transportation, (Special Report 155), Transportation Research Board, (proceedings of a conference held April 3-5, 1974, Washington, D.C.), 1975.

Heenan, W.G., "The Economic Effect of Rapid Transit On Real Estate Development," The Appraisal Journal, April 1965, 213-224.

Heggie, I.G. (Ed.), Modal Choice and the Value of Travel Time, Clarendon Press, 1976.

Hemmens, G.C. (Ed.), Urban Development Models, (Special Report 97), Highway Research Board (Proceedings of a Conference held June 26-30, 1967, Dartmouth College, Hanover, N.H.), 1967.

Herman, S.R., et al., The Effect of the Washington Metro On Urban Property Values, Washington D.C., (Prepared for the U.S. Dept. of Transportation), 1978.

Hitchcock, J.R. and A. Waterhouse, The Impact of Expressways On Adjacent Apartments: A Case Study Of Metropolitan Toronto, Toronto, Prepared by Joint Program in Transportation: University of Toronto and York University, 1973.

Hogan, P.E., A Case For Environmental Aesthetics In Urban Transportation Planning, Unpublished Paper, Victoria: University of Victoria, 1979, 45-50.

Hogan, P.E., Station Count Data Collection: Significance Tests, Victoria, CRD Transit Planning Department, 1982.

Hogan, P.E., Trip Generation Analysis, Unpublished Paper, Victoria, University of Victoria, 1980.

Hooker, R.W. and K.R. Potter, The Impact Of A New Interstate Highway On A Corridor: An Input-Output Analysis, University Of Wyoming, 1971.

Hopkinson, R. and N. Watson, Visual Intrusion Studies: Report On Work Completed May to October 1971, London, (Prepared for the Dept. of the Environment), 1971.

Hopkinson, R. and N. Watson, Visual Intrusion Studies: Studies In Quantitative Assessment In Relation To Urban Motorways, London, Environmental Design Consultants, 1972.

Hopkinson, R. and Watson, H., The Visual Effects Of Roads and Traffic, London, (Prepared for Secretary of State (U.B), Dept. of Environment), 1974.

Horning, G.H., M.I. Rubenstein and H. Gadamy, "Noise Impact Study for A Proposed Residential Development In Ontario: A Case Study, "Annual Conference Preprints, Design Technical Session and Workshops, Ottawa, Roads and Transportation Association of Canada, 1977.

Huddart, L., "Visual Intrusion of Roads and Traffic: A Case Study In the Lake District," TRRL Supplementary Report 186 VC, Berkshire, G.B., Transport and Road Research Laboratory, 1976.

Hutchinson, B.G., "An Approach to the Economic Evaluation of Urban Transportation Investments," Highway Research Record, No. 316, 1970, 72-86.

Hutchinson, B.G., Some Urban Transportation Myths; Occasional Paper No. 5, Waterloo, Faculty Of Environmental Studies, University of Waterloo, 1972.

Hutchinson, B.G., Transportation and the Vancouver Central Business District, Vancouver, (Prepared for the Greater Vancouver Regional District Planning Department), 1971.

Hutchinson, B.G., Urban Structure Determinants of Public Transport Efficiency in Canadian Urban Areas, Ottawa, Transport Canada, 1980.

Hutchinson, J.B., Transportation and the Environment, Boulder, Cal., Westview Press, 1977.

Hyman, G.M. and A.G. Wilson, The Effects of Changes In Travel Costs On Trip Distribution and Modal Split, London, Centre for Environmental Studies, 1971.

Jackson, J.N. and J.L. Northey, The Impact of Highway Development On Land Use, Vancouver, Dept. of Community and Regional Planning: University of British Columbia, June 1963.

Jackson, W.H. and G.E. Leveck, Corridor Noise Impact Assessment: Proceedings of the 1979 Annual Conference, Design Session and Workshops, Regina, Sask., Roads and Transportation Association of Canada, Sept. 17-20, 1979.

Jackson, W.H. and G.E. Leveck, "Fisher-University-Hellman Corridor Noise Impact Assessment," Annual Conference Preprints, Design Technical Session and Workshops, Ottawa, Roads and Transportation Association of Canada, 1979.

James, F.J. (Ed.), Models of Employment and Residence Location, New Brunswick, New Jersey, Centre for Urban Policy Research, Rutgers University: The State University of New Jersey, 1974.

Jansen, D., "Vancouver Prepares For 'Ride Into The Future'," Mass Transit, IX, No. 7, 1982.

Johnston, G.W., Annoyance Measurements Related To Urban Traffic Noise Exposure, Toronto, Prepared by the Joint Program In Transportation, University of Toronto and York University, 1973.

Kearns, J.H., The Economic Impact Of the Yonge Street Subway, Toronto, Toronto Transit Commission, 1964.

Mathias, P., "Rapid Transit Pays For Itself In Many Ways," The Financial Post, March 20, 1965.

Kingston, T.M., Traffic Noise Research, London, Department of Planning and Transportation, Greater London Council, 1973.

Komori, E., Developing A Methodology To Predict Noise Levels From the Proposed Light Rail Transit, Vancouver, 1977.

Kurzweil, L.R., Noise Assessment and Abatement In Rapid Transit Systems: Report on the Massachusetts Bay Transportation Authority, Cambridge, Mass., (Prepared for the U.S. Dept. of Transportation, Trans. Systems Centre), 1974.

Kuun, Z., A Review of Methods to Improve The Utilization of Pattulo Bridge, Vancouver, Zoltan Kuun Associates, (Prepared for the Ministry of Highways and Public Works, Greater Vancouver Regional District, B.C. Hydro and Power Authority and the local municipalities of New Westminster, Burnaby, Surrey and Delta), February 1978.

Lane, J.S., L.R. Grenzeback, T.J. Martin, and S.C. Lockwood, Impact Assessment Guidelines: The Role of the No-Build Alternative In the Evaluation Of Transportation Projects, (Prepared for National Research Council (U.S.), Transportation Research Board), National Cooperative Highways Research Program Report, 1977.

Langley, D., Directions for Transit in the Capital Region: Transportation Costs Concerns, Victoria, Regional Planning Dept. Capital Regional District, 1982.

Langley, D.W. et. al., Evaluation of Population of Land Use Trends 1980-85, (Transit Planning Program), Victoria, CRD Transit Planning Department, 1981.

Larson, A.R., R.S. Jacobsen, V.W. Hall, and D.G. Randolph Jr., Passive Vehicle Automated Guideway Transit" Documentation of Previous Work and Assessment of Impact of New Technology On This Concept, Dallas, Tx., Vought Corp., (Prepared for U.S. Department of Transportation, UMTA), August, 1980.

Lee, D., How To Do A Transit Station Land Use Impact Study, Iowa City, Prepared by the Institute of Urban and Regional Research, University of Iowa, 1978.

Lemly, J., Expressway Influence On Land Use and Value: Altanta 1941-1956, Georgia State Highway Department, 1958.

Lewis, P.F., D. Lowenthal and Yi-Fu Tuan, Visual Blight In America, (and other Essays), Resource Paper No. 23, Commission on College Geography, Associatfon of American Geographers, 1973.

Lord, I.J. and J.R. Miron, Modelling the Impact of Proposed Transportation Networks on the Toronto-Centered Region, Toronto, Prepared by the Joint Program in Transportation: University of Toronto and York University, 1971.

Lynch, K., The Image of the City, Cambridge, Mass., The M.I.T. Press, 1960.

Lynch, K., Managing the Sense of Region, Cambridge, the M.I.T. Press, 1976.

Manning,I., The Journey to Work, George Allen and Unwin, 1978.

Manuel, J. and H. Gadamy, "Traffic Noise Control in land use Planning," Annual Conference Preprints, Design Technical Session and Workshops, Ottawa, Roads and Transportation Association of Canada, 1979.

Markowitz, J. and M. Reynolds, "Data needs for measuring the impacts of new transportation systems: The Bart Experience," Computers, Local Government and Productivity, Papers from the Thirteenth Annual Conference of the Urban and Regional Information Systems Association, Seattle, 1975, 253-266.

Mercer, C., Living In Cities: Psychology and the Urban Environment, Pellican Books, Penguin, 1975.

Miller, S.F., "Effects Of Proposed Highway Improvements On Property Values," Highway Research Report, No. 114, 1971.

Minkus, D., Impact of Bay Area Rapid Transit (BART) On Bay Area Institutions and Lifestyles, San Francisco, Prepared with Metropolitan Transportation Commission, (Prepared for U.S. Department of Transportation, and Department of Housing and Urban Development, Wash. D.C.), April 1979.

Morier, G. (Ed.), "On The Tightrope With Canadian Transit," RTAC News, VIII No. 3, 1982, 2-7.

Morrall, J.F., Work Trip Distribution and Modal Split In the Metropolitan Toronto Region, Waterloo, University of Waterloo, Dept. of Civil Engineering, 1971.

Muller, et al., "The Impact Of Beltways On Central Business District: A Case Study of Richmond," Urban Institutes, Washington, D.C., 1978.

Murray, B.H. and B.J. Niemann Jr., "Visual Quality Testimony In An Adversary Setting," Proceedings Of Our National Landscape: A Conference On Applied Techniques for Analysis and Management of the Visual Resource, U.S.D.A., Forest Service, General Technical Report PSW-35, Washington, D.C., U.S. Government Printing Office, 1979.

McAllister, D.M., *Evaluation In Environmental Planning*, Cambridge, Mass., the M.I.T. Press, 1980.

McCoomb, L.A., and R.G. Rice, "*The Role of Statistics Canada Data in Transportation Planning*," RTAC Forum, V No. 2, (Published by the Road and Transportation Association of Canada), Ottawa, 1982.

Paaswell, R.E. and J. Berechman, et al., *An Analysis Of Rapid Transit Investments: The Buffalo Experience*, Dept. of Enviornmental Design, State University of New York at Buffalo, (also prepared for U.S. Dept. of Transportation, UMTA).

Page, R.S. (Ed.), *Joint Development Market Place*, Washington, D.C., (Proceedings of a conference under the same name held June 25-27, 1978 in Washington, D.C.), Prepared by Public Technology, Inc. (Sponsored by U.S. Dept. of Transportation, UMTA and the Office of the Secretary, Intergovernmental Affairs through the Urban Consortium, Urban Land Institute and Public Technology, Inc.), 1978.

Parkinson, T., *Light Rapid Transit For Greater Vancouver: Feasibility Study, Transport Consulting*, (Prepared for B.C. Bureau of Transit Services), 1974.

Parkinson, T., *A Preliminary Study of Light Rapid Transit in Vancouver*, (Prepared for the Greater Vancouver Regional District Planning Department), 1972.

Parr, A.L. (Ed.), et al., *Burnaby Metrotown*, Burnaby Municipal Planning Department, (Assistance by Norman Hotson Architects), June 1977.

Partridge, T.J., *ALRT Ridership Forecasts For Greater Vancouver*, Vancouver, Hickling-Partners Inc., (For B.C. Transit), 1982.

Pillar, W.A., "Canada's LRC Enters High Speed Race For U.S. Business," *Mass Transit*, IX No. 11, 1982.

Pitt, D.G. and E.H. Zube, "The Q-Sort Method: Use In Landscape Assessment Research and Landscape Planning," *Proceedings of Our National Landscape: A Conference On Applied Techiques for Analysis and Management of the Visual Resource*, Washington, D.C., USDA, Forest Service General Technical Report PSW-35, U.S. Government Printing Office, 1979, 227-234.

Porteous, J.D., *Environment and Behaviour: Planning and Everyday Urban Life*, Addison-Wesley Publishing Company, 1977.

Porteous, J.D., *Urban Environmental Aesthetics*, (unpublished manuscript), Victoria, University of Victoria, 1979.

Porter, A.L., F.A. Rossini, "Technology Assessment/Environmental Impact Assessment: Toward Intergrated Assessment," *IEEE* No. 8 (For Trans Syst. Man Cybern.), August 1980.

Porter, A.L. F.A. Rossini, S.R. Carpenter and A.T. Roper, *A Guidebook For Technology Assessment and Impact Analysis*, New York, Elsevier, North Holland, Inc., 1980.

Powell, A. (Ed.), *The City, Attacking Modern Myths*, Toronto, McClelland and Stewart Ltd., 1972.

Quinby, H.D. and J.E. Everson et. al., *Vancouver Transportation Study*, Vancouver, B.C.; Parsons, Brinkerhoff, Quad and Douglas Engineers, (Prepared for the City of Vancouver), October, 1968.

Rapoport, A., *Human Aspects of Urban Form: Towards A Man-Environment Approach To Urban Form and Design*, Pergamon Press, 1977.

Relph, E., *Place and Placelessness*, London, Pion Ltd., 1976.

Robinson, J.S., and R.E. Skorpil, "The Cost Of Expanding Urban Transportation - Highways Versus Rapid Transit," *Westinghouse Engineer*, January 1970, 9-14.

Roer, P., "Some Implications Of Altering The Balance Between Public Transit and Highway Capacities In Urban Areas", *The Logistics and Transportation Review*, II No. 3, 1975.

Ross, H.S. and G.M. Smerk, "Institutionalization Of Mass Transportation In The Community", XXXIII No. 4, *TRAFFIC QUARTERLY*, Westport, Conn., 1979.

Saarinen, T.S., *Perception of Environment*, Resource Paper No. 5, (Commission on College Georgaphy), Association of American Geographers, 1969.

Sage, A.P., *Methodology For Large Scale Systems*, New York, McGraw-Hill Book Company, 1977.

Scott, W.S., and G.D. Hamilton, *Burnaby Transportation Study To 1985*, Burnaby, Burnaby Planning Department, March 1974.

Shawcroft, R.G., E.M. Horwood and M.S. Lester, *Potential For Betterment District Financing and Joint Development Applications To Surface Transit*, Seattle, Washington, (Research Report No. 77 U.S. Dept. of Transportation, UMTA-WA-11-0005-RR-77-7), Prepared by Urban Transportation Program, Dept. of Civil Engineering, U. of Wash., 1977.

Sherret, A., *Bay Area Rapid Transit's (BART's) First Five Years: Transportation and Travel Impacts*, Prepared by the Metropolitan Transportation Commission and Peat, Marwick, Mitchell & Co., San Francisco, (Prepared for U.S. Dept. of Transportation and Dept. of Housing and Urban Development), April 1979.

Shortreed, J.H. and K. Vaga, "Impact of Transfers On Transit," *RTAC Forum*, V No. 2, 1983, 38-44.

Slee, B.J., "Simulating the Appearance of Rural Roads," *TRRL Supplementary Report 426*, Bershire, G.B., Transportation and Road Research Laboratory, 1979.

Smith, D.P. and F.L. Hall, "The Choice of Travel Mode Under Hypothetical Conditions: A Disaggregate Analysis," *RTAC Forum*, III, No. 2, Toronto, 1981.

Spaxman, R. (Ed.), *ALRT in the Broadway Station Area: Impacts and Solutions*, Vancouver, (Three Reports issued by the Vancouver City Planning Dept. and endorsed by Vancouver City Council - Manager's Reports dated 9-26-83, 8-29-83 and 8-5-83), 1983.

Spaxman, R. (Ed.), ALRT: A Noise Study: A Discussion Paper, Vancouver, (Prepared as part of the "Planning for the Community and Rapid Transit" series), City of Vancouver Planning Dept., April 1983.

Spaxman, R. (Ed.), The Broadway Station Area, Vancouver, Planning Department City of Vancouver, (Part of 'Planning for the Community and Rapid Transit' series), January 1983.

Spaxman, R. (Ed.), The Joyce Station Area, Vancouver, Planning Department City of Vancouver, (Part of the 'Planning for the Community and Rapid Transit' series), January 1983.

Spaxman, E. (Ed.), Nanaimo and 29th Station Areas, Vancouver, Planning Dept. City of Vancouver, (Part of the 'Planning for the Community and Rapid Transit' series), January 1983.

Stewart, G.N. and N.A., Urban Transportation Planning Guide, Toronto, (For Project Committee On Urban Transportation: Roads and Transportation Association of Canada), University of Toronto Press, 1977.

Stewart, S.E., An Overview of Transit Scheduling Experiments, Ottawa, Transport Canada, (TP 1942), 1979.

Stokols, D. (Ed.), Perspectives On Environment and Behaviour; Theory Research and Applications, Plenum Press, 1977.

Stopher, P.R. and D.A. Hensher, Behavioural Travel Modelling, London, Croom Helm, 1979.

Stopher, P.R. and A.H. Meyburg, Behavioural Travel-Demand Models, Lexington, Lexington Books, D.C. Heath and Co., 1976.

Stopher, P.R. and A.H. Meyburg, Urban Transportation Modeling and Planning, Lexington, Lexington Books, D.C. Heath and Company, 1975.

Stopher, P.R., A.H. Meyburg and W. Brog, (Ed.), New Horizons In Travel-Behaviour Research, Lexington, Lexington Books, D.C. Heath and Company, 1979.

Stringer, P. and H. Wenzel, Transportation Planning For A Better Environment, New York, Plenum Press, 1976.

Sullivan, B.E., Preliminary Plan For Immediate Improvement To Public Transportation in Greater Vancouver, Spatial Dynamics, (Prepared For the Greater Vancouver Regional District, Planning Dept.), September 1971.

Sullivan, J.B. and P. Montgomery, Evaluating Highway Environmental Impacts, (2 Reports), 1973.

Sullivan, E.C., A. Gellman, Dr. Garrison et. al., Technology Assessment Of Future Intercity Passenger Transportation Systems, Volume 6: Impact Assessment, Contributing agencies: Peat, Marwick, Mitchell and Company, University of California, Stanford University, Gellman Research Associates, Inc. and

Science Applications, Inc. (Prepared for N.A.S.A. and the U.S. Dept. of Transportation), March 1976.

Suzuki, H., "Results of A Questionnaire Survey On the Concept Concerning The Relationship Between Man and Space," *I.A.T.S.S. Research* VII, International Association of Traffic and Safety Sciences, 1983.

Taebel, D.A. and J.V. Cornehls, *The Political Economy of Urban Transportation*, Kennikate Press, 1977.

Thiel, F., "Highway Studies Relevant To Analysis Of Rapid Transit," *Highway Research Board, Special Report III*, 1970, 33-42.

Thompson, G.L. *A Macro Analysis of Variables Influencing Transit Usage*, Victoria, Bureau of Transit Services (B.C.), 1973.

Thomson, M.J., *Great Cities and Their Traffic*, Harmondsworth, Middlesex, Peregrine Books, Penguin, 1977.

Toft, M., "Transit Reshapes Canada's Cities," *Canadian Building*, XXXII No. 5, (Reprinted), May 1982.

Tuan, Yi-Fu, *Topophilia: A Study of Environmental Perception, Attitudes, and Values*, Englewood Cliffs, New Jersey, Prentice-Hall Inc., 1974.

Voorhees, A.M. et al., *Guidelines for Assessing the Environmental Impact of Public Mass Transportation Projects: Notebooks 1-5*, Washington, *Alan M Voorhees and Associates Ltd.*, (Prepared for U.S. Dept. of Transportation, Environment and Safety), 1979.

Wagner, R.H., *Environment and Man*, New York, W.W. Norton & Co. Inc., 1971.

Ward, B., *The Home Of Man*, Toronto, McCllelland and Stewart Ltd., 1976.

Watkins, L.H., *Environmental Impact of Roads and Traffic*, London New Jersey, Applied Scinece Publishers, 1981.

Watson, P.L., *The Value of Time; Behavioural Models Of Modal Choice*, Lexington, Lexington Books, D.C. Heath & Co., 1974.

Wear, J., "Design of Noise Barriers," *Annual Conference Preprints, Design Technical Session and Workshops*, Ottawa, Roads and Transportation Association of Canada, 1979.

Weaver, J.C., *Shaping The Canadian City: Essays On Urban Politics and Policies, 1980-1920*, (Monographs on Canadian Urban Government, No. 1), The Institute of Public Administration of Canada, 1977.

Werner, C., "Formal Problems Of Transportation Impact Research," *Annals Of Regional Science*, December 1970, 134-149.

Wilson, A.G., Urban and Regional Models In Geography and Planning, London, John Wiley and Sons, 1974.

Willson, G.D. (Ed.), Environmental Impact Assessment: Northwest L.R.T. Alignment, G.W. Associates Consulting, Ltd., (Prepared for City of Calgary "Mayor's N.W. LRT Task Force), July 1981.

Wilson-Hodges, C., The Measurement of Landscape Aesthetics; Working Paper No. 2, Toronto, Institute Of Environmental Studies, University of Toronto, 1978.

Whicker, D., Vancouver ALRT Baseline Noise and Vibration Survey: Measurement Sites, Barron and Associates, Vancouver, (Prepared for MacLaren Plansearch Corp. as part of the Study Design: ALRT Technology Impact Study - B.C. Transit/Transport Canada), 1983.

Wohlwill, J.F., "Environmental Aesthetics: The Environment As A Source Of Affect," Human Behaviour and Environment (ch. 2) Vol 1, Altman and Wohlwill (Ed.), Plenum Press, 1976.

Yeung, C.C.S., R.G. Rice and T.A. Lambe, "The Influence Of Household Income On the Choice and Valuation Of Transportation Modes", RTAC Forum, III, No. 2, Road and Transportation Association of Canada, 1981.

Zube, E.H., "Perception Of Landscape and Land Use," Human Behaviour and Environment, (ch. 3) Vol. 2., Altman and Wohlwill (Ed.), Plenum Press, 1976.

Titles

Acoustics Technology in Land Use Planning, Volume 1: Analysis of Noise Impact, Toronto, Ontario Ministry of the Environment, 1977.

Acoustics Technology In Land Use Planning, Volume 2: Road Traffic Noise, Toronto, Ontario Ministry of the Environment, 1977.

ALRT Commercial Drive - Impact Study, Vancouver, Garth Edge International Inc. and Allen Parker and Associates Ltd., (Prepared for B.C. Transit), Dec. 1981.

ALRT Economic Benefits Study, Vancouver, Garth Edge International Inc., (Prepared for B.C. Transit), September 1981.

ALRT Specifications: System Description, Vol. 1, Vancouver, Metro Canada Ltd., (Prepared for B.C. Transit), February 1982.

Alternatives Analysis/Draft Environmental Impact Statement for the Guadalupe Corridor in Santa Clara, California, Washington, U.S. Department of Transportation, UMTA, 1981.

Assessment Of the Bay Area Rapid Transit (BART) Impact Program, National Academy of Sciences, Washington, D.C., National Research Council, 1980.

Banfield Transitway Project: Light Rail Transit Line and Banfield Freeway Improvements, Prepared for the U.S. Dept. of Transportation, FHWA and UMTA), August 1980. (Chapter 4.9 Accoustical Impacts 4.9.1-4.9-22).

BART In the San Francisco Bay Area: The Final Report Of the BART Impact Program, San Francisco, Metropolitan Transportation Commission, (Prepared for U.S. Dept. of Transportation, and Dept. of Housing and Urban Development, Washington, D.C.), June 1979.

Burnaby Transportation Study to 1985, Burnaby, City of Burnaby Planning Department, March 1974.

Bus Lanes and Busway Systems, Paris, Organization for Economic Cooperation and Development, 1976.

A Bypass Study Of the Economic and Social Impact Of A Highway, Blairsville, Pennsylvania State Agricultural Experimental Station, A.E. & R.S. No. 35, 1962.

Commerical Development In Greater Vancouver, 1970-1979, Greater Vancouver Regional District, February 1981.

Cross-Sectional Analysis of Canadian Urban Transit Systems Performance In 1976, Ottawa, Urban Transportation Research Branch, Transport Canada, 1979.

Downtown Guidelines: Character Areas, Prepared by the City of Vancouver Planning Department, July 1975.

Downtown Guidelines: Design Guidelines, Prepared by the City of Vancouver Planning Department, July 1975.

Downtown Guidelines: Planning Policies, Prepared by the City of Vancouver Planning Department, September 1975.

Downtown Vancouver Transit Concepts: Summary Reports, Prepared by Wilbur Smith & Associates, (Prepared for Greater Vancouver Regional District Planning Department), 1972.

Downtown Zoning: Official Development Plan, Prepared by the City of Vancouver Planning Department, July 1975.

Economic Effects Of A Highway Change On Fairbault, Minn., University of Minnesota, Dept. of Agriculture Economics, 1960.

Economic Impact Studies On A Portion Of the Baltimore Beltway, Maryland State Roads Commission, 1960.

Environmental Impact Assessment Stage II: Working Paper No. 9, Edmonton, MRL Planned Environments Ltd., (Prepared for the Northeast LRT Corridor Study - City of Edmonton), November 1977.

"Environmental Impact Of An Urban Expressway", *Ekistics, XXIX* No. 170, 1970, 63-67.

The Environmental Impacts of BART, San Francisco, Metropolitan Transportation Commission, (Prepared for the U.S. Dept. of Transportation and Dept. of Housing and Urban Development), December 1978.

EPA's Rulemaking Programs and Strategies For Reducing Surface and Transportation Noise, Washington, D.C., U.S. Environmental Protection Agency, 1978.

Geometric Design Standards For Canadian Roads and Streets, Toronto, Roads and Transportation Association of Canada, 1976.

Greater Vancouver ALRT System, Metro Canada Ltd., (Prepared for B.C. Transit), Feb. 1982.

Greater Vancouver Growth Prospects, Trends and Forecasts, Vancouver, Greater Vancouver Regional District, Planning Department, 1983.

Greater Vancouver's Land Resource, Current Use and Land Supply, Greater Vancouver Regional District, September 1982.

Greater Vancouver Transit System: Directions for Transit in the 1980's - A Conceptual Plan, Vancouver, Greater Vancouver Regional District, Transit Planning Dept., 1981.

"Highway Economic Impact Studies In Urban Communities Of New Mexico," *Bulletin No. 16* - New Mexico Highway Dept., (Sponsored in part by the U.S. Bureau of Public roads), 1960.

Impact Assessment Stage I: Working Paper No. 3., Edmonton, MRL Planned Environments Ltd., (Prepared for Northeast Light Rapid Transit Corridor Study: City of Edmonton), July 1977.

The Impact of BART On Economics and Finance, San Fancisco, Metropolitan Transportation Commission, (Prepared for the U.S. Dept. of Transportation and the Dept. of Housing and Urban Development), December 1979.

The Impact of BART On Land Use and Urban Development, San Francisco, Metropolitan Transportation Commission, (Prepared for the U.S. Dept. of Transportation and Dept. of Housing and Urban Development), December 1978.

Impact of BART On Transportation and Travel: Interim Service Findings, San Francisco, Metropolitan Transportation Commission, (Prepared for U.S. Dept. of Transportation and Dept. of Housing and Urban Development), July 1976.

Impact of Highways On Land Use and Property Values, Michigan State University, Highway Traffic Center: College of Business and Public Service, 1958.

Implementation of the N-Dimensional LOGIT Model, San Diego, Peat, Marwick, Mitchell and Co., (Prepared for the Comprehensive Planning Organization, San Diego County, Sponsored by the U.S. Dept. of Transportation), 1972.

"The Indirect Effects Of Highway Investment", Journal of Regional Studies, (ICE Highways and the Environment), 1976.

The Journey to Work, An Overview of Greater Vancouver Transportation Situation, Greater Vancouver Regional District, 1982.

The Land Use and Urban Development Impacts of Beltways, V. 1-4, Washington, D.C., U.S. Federal Highway Administration, 1980.

Land Use Impacts of Rapid Transit: Implications of Recent Experience, Final Report, Washington, D.C., Prepared by DeLeuw Cather and Company (Prepared for the U.S. Department of Transportation), 1977.

Land Use Study - L.R.T. South Corridor: Background Information Package, Calgary, Planning Department, City of Calgary, 1979.

Land Value Capture, Ottawa, Prepared by Planning Collaborative Inc., (Prepared for the Ministry of State for Urban Affairs), 1979.

Light Rapid Transit For Greater Vancouver: Summary Report, Vancouver, Urban Transit Development Corporation, (Prepared for B.C. Transit, Victoria), September 1980.

LRT - Impacts On Low Density Municipalities, Richmond, B.C., Engineering Department, City of Richmond, 1981.

L.R.T. South Corridor Land Use Study, Calgary, Planning Department, City of Calgary, 1981.

May 1975 Areawide Travel Survey: Documentation and Evaluation of Procedures, San Francisco, Peat Marwick Mitchel and Co., (Prepared for BART Impact Program), October 1976.

Model of Individual's Choice of Travel Mode, the, Ottawa, N.D. Lea and Associates, (Prepared for the Federation of Canadian Municipalities and sponsored by the Regional Municipality of Ottawa-Carlton), 1979.

N.E. Sector Commuter Rail, Feasibility Study, Vancouver, B.C. Transit Authority (formerly U.T.A.), May 1980.

Noise Barrier Social Impact Study, Downsview, Ont., Research and Development Division, Ontario Ministry of Transportation and Communications, 1980.

Noise Impact Inventory of Elevated Structures in U.S. Urban Rail Rapid Transit Systems, Cambridge, Ma., Bolt Beranek and Newman, Inc., (Prepared for Transportation Systems Center, Cambridge, Ma., and U.S. Department of Transportation, UMTA, Washington, D.C.), September 1980.

North Vancouver Origin - Destination Survey: Final Report, Vancouver, B.C. Hydro and Power Authority, May 1978.

Northwest L.R.T.: Report of the Mayor's Task Force, City of Calgary, July 1981.

Official Regional Plan 1982 Monitoring Report, Vancouver, Greater Vancouver Regional District, Planning Department, 1983.

On Track For the 80's, Vancouver, Prepared by B.C. Transit, 1981.

Performance and Impact Of the Alternatives Year 2000, Toronto, Metropolitan Toronto Transportation Plan Review, 1975. (Report 63).

Performance and Impact of the Alternatives Year 2000: Analysis of Environmental Effects, Toronto, Metropolitan Toronto Transportation Plan Review, 1975.

Performance and Impacts Of the Alternatives Year 2000: Analysis of Social Effects, Washington, D.C., Metropolitan Toronto Transportation Plan Review, 1974. (Report 63.12).

"Planning and Evaluation Process, The", The Transportation Plan: Part 3, Vol. 1, Edmonton, Alta., City of Edmonton Engineering and Transportation Dept., 1976.

Population, Growth and Distribution, Vancouver, Lower Mainland Official Regional Plan Update, Prepared by a committee of the four lower mainland regional districts and the B.C. provincial government (Municipal Affairs), December 1978.

Population Housing, Labour Force and Employment Growth, Greater Vancouver Regional District, February 1981.

Population, Labour Force and Housing Forecasts 1981-2001: Technical Memorandum No. 1, Vancouver, Lower Mainland Official Regional Plan Update, Prepared by a committee of the four lower mainland regional districts and the B.C. provincial government, December 1978.

Preliminary Examination Of Commuter Rail Service For the North Shore, Vancouver, B.C. Transit, September, 1981.

"Public Transportation Planning and Development", Transportation Research Record (TRR 735) National Academy of Sciences, 1979.

Rapid Transit Investigation: 1978-Terms of Reference, Vancouver, Greater Vancouver Regional District, 1978.

Rapid Transit Investigation, 1978: Objectives, Tasks, and Organization, Vancouver, Prepared by Greater Vancouver Regional District Planning Department, 1978.

Rapid Transit Project: Report 1-Regional Transit Strategy, Vancouver, Prepared by the Greater Vancouver Regional District, Planning Dept., 1979.

Rapid Transit Project: Report 2-Rapid Transit Preliminary Design, Vancouver, Prepared by the Greater Vancouver Regional District, Planning Department, 1978.

Rapid Transit Project: Report 3-Short Term Bus Improvements For Greater Vancouver, Vancouver, Prepared by the Greater Vancouver Regional District, Planning Dept., 1979.

Rapid Transit Project: Report 4-Light Rapid Transit System Choice, Vancouver, Prepared by the Greater Vancouver Regional District, Planning Department, 1.

Rapid Transit Project: Report 5-Automated Light Rapid Transit: Preliminary Service Specifications, Vancouver, Prepared by the Greater Vancouver Regional District Planning Department, 1981.

Rapid Transit Study: Land Use and Environmental Review, Toronto, Metropolitan Toronto Planning Department, (Metro/T.T.C. Background Report 4), May 1982.

Rapid Transit Technical Report One and Two: Corridor Priorities, Suitable Types, Vancouver, Prepared by Greater Vancouver Regional District Planning Department, 1978.

Report on the Greater Vancouver Area Rapid Transit Study: Technical Report, Vancouver, Prepared by Delcan, (Prepared for the Greater Vancouver Regional District Planning Dept.), 1970.

A Residential Growth Management Study for Burnaby, Burnaby, Planning Dept. for Burnaby Municipality, Sept. 1980.

A Review of the Experience of Activities of the Urban Transportation Research Branch: 1976-1979, Ottawa Urban Transportation Research Branch, Transport Canada, 1979.

Review of Trip Generation Procedures, A, Toronto, Trip Generation Project Committee, Roads and Transportation Association of Canada, 1974.

Road and Rail Noise: Effects On Housing, Ottawa, Central Mortgage and Housing Corporation, 1977.

"Roads and the Environment: A Collection of Papers Prepared at TRRL," TRRL Supplementary Report 356, Bershire, G.B., Transportation and Road Research Laboratory, 1980.

"Roadscape", IATSS 423 Project Team, IATSS Research, VII, International Association of Traffic and Safety Sciences, 1983, 3-14.

South LRT Impact Study: Study Design, Calgary, City of Calgary Transportation Department, Planning Division, 1982.

South LRT Pre-Functional Planning Study: Impact Assessment, Edmonton, Transportation Management, City of Edmonton, April 1983.

South LRT Review Study Report: Recommended Alignment and Implementation, Edmonton, Transportation Management of the City of Edmonton, May 1983.

Statement of Work For Greater Vancouver Automated Light Rapid Transit, B.C. Transit, January 1981.

Statement On Next Stage Public Transportation Improvements, Vancouver, Prepared by the Greater Vancouver Regional District Planning Department, 1974.

Strength and Weakness - Part 8: The Environment and the Transportation System, Toronto, Metropolitan Toronto Transportation Plan Review, 1973.

Study Of Social, Economic and Environmental Impact Of Highway Transportation Facilities On Urban Communities, Olympia, Washington Dept. of Highways, (PB 197-626), 1968.

Suburban Office Development In Greater Vancouver, A Survey of Existing Firms, Greater Vancouver Regional District, September 1982.

Surveys of Transbay Travel, October 1974: Data Collection Methodology, San Francisco, Peat Marwick Mitchel and Co., (Prepared for the BART Impact Program), May 1975.

Technology Assessment Of Future Intercity Passenger Transportation Systems; Volume 6 Impact Assessment, Burlingame, Calif., Peat Marwick Mitchell and Co., (Prepared for U.S. Dept. of Transportation and University of California in San Diego, Stanford University, Gellman Resources Association and Science Applications, Inc.)., March 1976.

Terms of Reference For A Preliminary Design Of LRT For Greater Vancouver, (DRAFT), Vancouver (Prepared For the Greater Vancouver Regional District, Planning Department), 1976.

CA1
DTC 820
84
I 51
c.2

Traffic Impact: A Study of the Effects of Selected Roads in Residential Living In Southern Westchester, Westchester County, N.Y. State, Dept. of Planning, 1954.

Transit Financing, Toronto, Prepared by Transit Financing Task Team, (Prepared for Metro/T.T.C. Transit Policy Committee), August 1979.

Transit Impact Study of the Lafayette BART Station Area, San Francisco, Stanford Research Institute, 1970.

Transit Rider Study Vancouver, Vancouver, Canadian Facts Co. Limited (Toronto), (Prepared for Canadian Car and Bus Advertising Ltd.), October 1966.

Transportation Facility Proximity Impact Assessment, Sacramento, Calif., Booz-Allen and Hamilton Inc., (Prepared for California Department of Transportation), 1976.

Trip Generation Analysis, Washington, D.C., U.S. Federal Highway Administration, Urban Planning Division, 1975.

"Roads and the Environment: A Collection of Papers Prepared at TRRL," TRRL Supplementary Report 356, Bershire, G.B., Transportation and Road Research Laboratory, 1980.

Ulogit Calibration Program; ULOGIT, Washington, Urban Mass Transportation Administration and the Federal (U.S.) Highway Administration, U.S. Dept. of Transportation, 1977.

ULOGIT Users Guide, Washington, UMTA & FHWA, U.S. Dept. of Transportation, 1977.

Urban Transport, Sector Policy Paper, New York, World Bank, 1975.

U.T.A. Review of the Urban Transportation Development Corporation's ALRT Proposal for Greater Vancouver, Urban Transit Authority of B.C., Oct. 1981.

Vancouver Travel Time, Prepared by Engineering Department City of Vancouver, January 1980.

VISITOR '79: British Columbia Visitors Travel Survey - 1979, TIDSA Publication (Sponsored by the Federal Dept. of Regional Economic Expansion and the B.C. Ministry of Industry and Small Business Development), B.C. Research, 1980.

Visual Simulation Techniques, Washington, D.C., U.S. Department of the Interior, U.S. Government Printing Office, 1980.

The Way Ahead: A Report On the State Of the Lower Mainland, Vancouver, Lower Mainland Official Regional Plan Update, Prepared by a committee of the four lower mainland regional districts and the B.C. Provincial Government, April 1979.

Year 1990: Transit Ridership Forecasts, Presage Research Ltd., Transport Canada, (TP 2204), 1978.

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